SUGARBEET RESEARCH

1974 REPORT

A Report to and for
the Sole Use of Cooperators

NOT FOR PUBLICATION

FOREWORD

SUGARBEET RESEARCH is an annual compilation of progress reports concerning incomplete research by Agricultural Research Service investigators and cooperators who are engaged in sugarbeet variety and production research. The report has been assembled by Dr. John S. McFarlane, Technical Advisor for sugarbeet variety and production research in the Western Region of the Agricultural Research Service. The report has been reproduced at the expense of the Beet Sugar Development Foundation, and is for the sole use of the cooperators. Much of the data has not been sufficiently confirmed to justify general release and interpretations may be modified with additional experimentation. The report is not intended for publication and should not be used for cited reference nor quoted in publicity or advertising. Reproduction of any portion of the material contained herein will not be permitted without the specific consent of the contributor or contributors.

The report presents results of investigations strengthened by contributions received under Cooperative Agreements between Agricultural Research Service, U.S. Department of Agriculture, and the Beet Sugar Development Foundation; the California Beet Growers Association, Ltd.; the Farmers and Manufacturers Beet Sugar Association; and the Red River Valley Sugarbeet Growers Association, Inc.

Trade names occur in this report solely to provide specific information and do not signify endorsement by the U.S. Department of Agriculture or the Beet Sugar Development Foundation.

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SUGARBEET RESEARCH

1974 Report

Section A

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SUMMARY OF ACCOMPLISHMENTS, 1974

YELLOWS RESISTANCE--The results of yellows and yield performance tests are summarized in tables for tests 874, 974, 1074, 1174, 1274, 1374, 1774, and 1874. Most of the entries in these tests were also evaluated for bolting and yield in tests 474, 574, and 674. A line designated C01 was made available to breeders from the yellows resistance program in 1974. These tests indicated that hybrids with the Y201 (C01) multigerm pollinator were generally higher yielding than equivalent hybrids with C17 (tests 574, 674, 874, and 974). However, the Y201 hybrids were slightly more yellows susceptible than the C17 hybrids, but yields under severe yellows infection were similar. A more bolting resistant line, Y231, selected from Y001, had performance characteristics similar to Y201. Part of the superiority of the Y201 and Y231 hybrids may be due to slightly better powdery mildew resistance (test 1874). Hybrids with 2718 (C3718 or C3718H0) continued to perform well. Vytomo (virus yellows tolerant line from Hilleshog) had a combination of high tonnage and sucrose but was only slightly resistant to BYV and susceptible to BWYV (test 1874). Bush Mono was also a high tonnage and high sugar cultivar (test 1774) but showed only slight yellows resistance under severe BYV-BWYV conditions. Both Bush Mono and Vytomo exhibited moderate powdery mildew resistance. Four accessions from the Netherlands developed in Dr. Cleij's yellows resistance breeding program varied from moderately resistant to moderately susceptible to BYV-BWYV (test 1774). Several of these accessions were quite resistant to powdery mildew. In the yellows evaluation tests, powdery mildew severity was generally observed to be more severe on the yellows infected treatments. Test 1274 summarizes the yellows reactions of hybrids submitted for testing by six sugarbeet companies. R. T. Lewellen, I. O. Skoyen, and J. S. McFarlane.

RECURRENT SELECTION FOR YELLOWS RESISTANCE--Mass selection has been of minimal success in self-fertile lines in which intercrossing is limited or nonexistent from generation to generation. Therefore, recurrent selection is being evaluated as a means of eventually obtaining yellows resistance within O-type, monogerm, self-fertile populations. Hopefully, while fixing yellows resistance, sufficient genetic variability can be maintained to permit selection for other desired characteristics. It is visualized that the products of recurrent selection could be used in a manner equivalent to those now used for open-pollinated lines or that specific self-fertile, inbred lines could be isolated for use as components of hybrids. Test 1174 presents the results of one cycle of selection for yellows resistance. Data from BYV-BWYV infected half-sib families were used to make divergent selections for sugar yield and sucrose concentration on the assumption that final performance of these infected families would partially depend upon their reaction to yellows. As measured by the populations derived from the selected families, shifts in yellows resistance can probably be made using yield as the selection criterion. R. T. Lewellen, I. O. Skoyen and J. S. McFarlane.

YIELD LOSS PER INTERVAL OF YELLOWS INFECTION--Test 1374 was grown to determine the relationship between the length of yellows infection and the damage caused by yellows within moderately resistant and susceptible breeding lines and hybrids. The results substantiate the finding of a similar test grown in 1972 (pages B3 and B22-23, 1972 Report, Sugarbeet Research). A nearly linear relationship exists between the date of infection and the loss due to yellows infection. The rate of loss is greater for the susceptible entries than it is for the resistant entries. However, as in most yellows evaluation tests at Salinas, loss data may be biased downward due to natural infection in the noninoculated treatment and actual losses are probably greater than measured. Natural infection of the noninoculated check treatment also probably causes the bias to be proportionally greater for susceptible entries than for more resistant entries. R. T. Lewellen, I. O. Skoyen, and J. S. McFarlane.

BEET MOSAIC VIRUS RESISTANCE--Seven pairs of near-isogenic lines that are differentiated by the alleles (Bm = BMV resistance, bm = BMV susceptibility) for beet mosaic reaction were evaluated (test 1874). When inoculated with BMV, sugar yield losses varied from 8.0 to 27.6% within the susceptible (bmbm) members, and 0 to 4.6% within the resistant (BmBm) members. The Bm allele appeared to be specific for BMV. When pairs were compared under the noninoculated, BYV, and BWYV treatments, the bmbm member of each pair had the higher sucrose concentration. When compared under separate BYV and BWYV infected treatments, most bmbm members had more yellows resistance. These correlated effects which suggest either pleiotropy or linkage are being investigated. Data from the separate BYV and BWYV inoculations indicated that in some lines BWYV may cause nearly or as much damage as BYV and that yellows resistance, e.g. of 813, is due to resistance to both BYV and BWYV. In general, BWYV caused a greater sugar reduction that BYV. Powdery mildew infection in test 1874 was rated significantly higher in the BYV and BWYV infected treatments than in the healthy treatments. R. T. Lewellen, and I. O. Skoyen.

RESISTANCE TO ERWINIA--Sixty-four entries were evaluated for resistance to an Erwinia species, the incitant of bacterial root rot (page A60). Each plant was inoculated with a suspension of bacterial cells immediately after being wounded. Mean rot ranged from 5.9 to 83.4% per root. F70-546 is quite resistant and its resistance appeared to be partially transmitted to the F_1 hybrids in which it is a component. Other components of presently grown hybrids are quite susceptible, e.g., F66-562HO and C17. A low percentage of Erwinia rot occurred in all field tests. Although low in comparison to the inoculated tests, the relative levels of infection between varieties appear to be indicative of their reaction to Erwinia in inoculated tests. Polycross families from one and two cycles of selection for Erwinia resistance from F70-13 were compared in an Erwinia inoculated test (page A63). Whereas F70-13 had a mean rating of 20.4% rot per root, most twice selected families showed less

than 2.0% rot per root. Two lines from the first Erwinia resistant selection cycle were evaluated in tests 574 and 1774. The line RR84 appeared to be superior to F70-13 for most characteristics, whereas RR8 was essentially equal to F70-13. Preliminary data indicate that Erwinia resistant selections can be made without adversely affecting other desirable traits. R. T. Lewellen and E. D. Whitney.

INTERSPECIFIC HYBRIDIZATION--Additional progress has been made in the transferral of nematode resistance from the wild Beta procumbens species to the sugarbeet. Several highly resistant diploid plants have been selected. A translocation of chromatin bearing the gene or genes for nematode resistance has taken place between B. procumbens and a sugarbeet chromosome. The rate of transmission is about 20%. The size of the translocated section must be reduced still further before the plant breeder can successfully incorporate nematode resistance into a commercial variety. Thirteen highly curly top resistant diploid plants were selected from 400 B_5 plants from vulgaris x corolliflora hybrids. The transmission rate of curly top resistance was about 4%. Helen Savitsky and J. S. McFarlane.

POWDERY MILDEW ON SUGARBEET--The disease was epiphytotic on sugarbeet in California in 1974. Mildew was first observed in the Imperial Valley in early April and spread to other production areas of the state in about three months. Results of mildew control tests at Salinas showed that the disease significantly reduced root yield, sucrose percentage and purity. Repeated spray applications of 10 lbs/A wettable sulfur, at 2-week intervals, increased sugar yield by 38%. Timing initial treatment with the first appearance of scattered patches of fungus appeared to be critical for optimum disease suppression. Sugarbeet plants appeared to become infected only after the leaf canopy was large and nearly covered the area between rows. I. O. Skoyen, R. T. Lewellen, and J. S. McFarlane.

POWDERY MILDEW RESISTANCE--Ratings of a large number of varieties and breeding lines showed a range in powdery mildew resistance. In general European and Russian varieties were more resistant than the curly top resistant varieties and breeding lines. None of the varieties or lines included in the 1974 trials were immune or highly resistant. If powdery mildew continues to be a problem, resistance will need to be incorporated into the curly top resistance varieties. Observations made in 1974 indicate that the genes for resistance may need to come from varieties and breeding lines that lack curly top resistance. J. S. McFarlane, R. T. Lewellen, and I. O. Skoyen.

EFFECT OF SEED GROWING ENVIRONMENT ON BOLTING RESISTANCE--Fourteen seed lots of USH9 and USH10 were included in a bolting resistance evaluation test at Salinas. The lots represented seed increases made at Salem, Oregon and Salinas, California between 1968 and 1973. Bolting was relatively light at Salinas in 1973 and the differences among seed lots

tended to be small (page A26). Greater differences were observed among seed lots increased in different years than among lots produced in any one year. All 1973 increases showed good bolting resistance whereas seed lots produced in 1969 showed significantly more bolters. Increases made at Salinas were similar in resistance to those made at Salem. Studies are underway to determine environmental factors responsible for differences in bolting behavior of various seed increases. J. S. McFarlane.

TOLERANCE TO WILTING CAUSED BY NEMATODE--Lines selected for nematode wilting tolerance by the Instituut voor Rationele Suikerproductie in the Netherlands were again evaluated at Salinas. In order to obtain a comparison of the performance of the lines when grown under severe nematode infestation and when grown under nematode free conditions, we fumigated a portion of a nematode infested field with methyl bromide. This enabled us to grow the two trials side by side and to treat them the same agronomically. As might be expected, only small differences in wilting occurred among lines in the fumigated area when placed under moisture stress. Differences in the severity of wilting were most striking in the nematode infested area (page A38). All lines selected in the Netherlands showed less wilting than did the US H10 check variety.

The yields of all selections were severely reduced by nematodes, but the reduction was less for the wilt tolerant selections than for the unselected check. When grown under nematode free conditions, the yield of the Dutch selections and of US H10 were similar (pages A37 and A38). These results, together with those obtained in previous years, demonstrate that the Instituut voor Rationele Suikerproductie has developed lines with improved wilting tolerance and that these lines yield better under severe nematode infestation than do unselected lines. J. S. McFarlane.

PERFORMANCE OF RUSSIAN VARIETIES--Twenty-four Russian varieties and six breeding lines were evaluated by sugarbeet researchers throughout the United States. Root yield of the 24 varieties varied greatly from one location to another. In general, the Russian varieties yielded well and had good sucrose. Most of the varieties lacked bolting resistance and could not be used for winter plantings in California. A few of the varieties exhibited some resistance to leaf spot and to rhizoctonia, but the level of resistance was inferior to that available in American varieties. No resistance was observed to either curly top or virus yellows. A moderate level of powdery mildew resistance was present in several varieties. All of the Russian varieties were damaged less by powdery mildew than was US H10. Breeding lines selected for resistance to Botrytis showed a moderate level of resistance to this storage rot organism. Only seven of the 24 varieties were described as possessing monogerm seed. The proportion of seed exhibiting the monogerm character ranged from 60% to 93%. None of the varieties utilized CMS. Several were anisoploid and had been produced by mixing tetraploids and diploids in the seed field. J. S. McFarlane.

VARIETY TRIALS, SALINAS, CALIFORNIA, 1973-74

Location: USDA Agricultural Research Station

Soil type: Sandy loam (Chualar series).

Previous crops: Vetch cover crop or barley, 1973; fallow, 1972; barley, 1971.

Fertilizer used: The 1973-74 yield trial fields received 1100 lbs/A agricultural dolomite lime (equivalent to 105% $CaCO_3$) broadcast and disced in to about 6" depth.

Tests 174 through 674 (bolting evaluation trials) were seeded between December 12 and 18, 1973. Preplant: 675 lbs/A 0:10:5 was broadcast and chiseled in before listing; 69 lbs/A actual N, as ammonium sulfate. Sidedressing: 50 lbs/A actual N, about March 8; 83 lbs/A actual N, April 10; 86 lbs/A actual N, June 11, 1974, all applications as ammonium sulfate.

Tests 774 through 1374 (variety yield trials) were seeded between January 28 and February 6, 1974. Preplant: 675 lbs/A 0:10:5 was broadcast and chiseled in before listing; 73 lbs/A actual N, as ammonium sulfate. Sidedressing: 87 lbs/A actual N, April 11-12 and 86 lbs/A actual N, June 11-13, 1974, both applications as ammonium sulfate.

Tests 1474 (Russian variety trial) and 1574 (Dutch and Polish variety trial) seeded February 26, 1974. Preplant: 685 lbs/A 0:10:5 was broadcast and chiseled in before listing; 70 lbs/A actual N as ammonium sulfate. Sidedressing: 105 lbs/A actual N, May 20 and 86 lbs/A actual N, both applications as ammonium sulfate.

Tests 1674 (S_1, sibbed, and testcross progeny trial) and 1774 (yellows evaluation trial of O.P. lines) were seeded April 16-17, 1974. Preplant: 675 lbs/A 0:10:5 was broadcast and chiseled in before listing; 69 lbs/A actual N, as ammonium sulfate. Sidedressing: 86 lbs/A actual N June 13-14, 1974.

Tests 1874 (Isogenic lines x viruses), 1974 (Inheritance of Erwinia resistance), and 2074 (Erwinia resistance evaluation) were seeded May 8-10, 1974. Preplant: 730 lbs/A agricultural lime and 650 lbs/A 0:10:5 broadcast and chiseled in before listing; 68 lbs/A actual N, as ammonium sulfate. Sidedressing: 83 lbs/A actual N, as ammonium sulfate, July 1, 1974.

Thinning dates:
Tests 174 through 674: February 6-9, 1974.
Tests 774 through 1374: March 11-14, 1974.
Tests 1474 and 1574: March 27, 1974.
Tests 1674 and 1774: May 20-22, 1974.
Tests 1874 through 2074: June 10-12, 1974.

Inoculation dates: Tests 874 and 974: May 30, 1974 with a combination of BYV-BWYV.
Tests 1074, 1174, and 1274: May 24, 1974 with a combination of BYV-BWYV.
Test 1374: April 25; May 30; July 3, and August 13, 1974 with a combination of BYV-BWYV.
Test 1774: June 27, 1974 with a combination of BYV-BWYV.
Test 1874: June 26, BMV; June 28, BYV; and June 28, 1974, BWYV.
Tests 1974 and 2074: July 18, 1974 with a suspension of Erwinia root rot bacterium.

Harvest dates: Tests 174 through 474 not harvested for yield.
Tests 574, 674, and 774: September 9-13, 1974.
Tests 874 and 974: September 16-20, 1974.
Tests 1074, 1174 and 1374: September 23-27, 1974.
Test 1274: September 30 and October 1, 1974.
Tests 1474 and 1574: October 2-4, 1974.
Test 1674-1: October 23-25, 1974.
1674-2: October 9-11, 1974.
1674-3: October 21-23, 1974.
Test 1774: October 7-9, 1974.
Test 1874: October 30-31, 1974.

Irrigation: By either furrow or sprinkler system as required at 7-14 day intervals.

Diseases and insects: Virus yellows infection was moderate during 1974. Aphid populations were controlled and the spread of yellows was slowed by spray applications of Meta-Systox R and sidedress applications of Temik 10G granules. Tests 174 through 1374 were sprayed with 2 pts/A Meta-Systox R on April 29, 1974. Tests 174 through 1574 were sidedressed with 25 lbs/A of Temik 10G between May 20 and May 30, 1974. Tests 1674 through 2074 were first sidedressed with about 15 lbs/A of Temik 10G on June 17, 1974, and with a second sidedressing of about 15 lbs/A on June 27-28, 1974.

Powdery mildew (Erysiphe polygoni DC. type) was severe in all sugarbeet tests in 1974. The mildew was first observed in the earliest seeded tests about mid-June. Spread was rapid within these tests as well as to subsequently seeded tests with the infection appearing when plants reached 12-14 weeks of age. By late July, sugarbeets seeded in mid-April showed scattered patches of mildew on essentially 100% of the plants. No general mildew control measures were used in 1974.

Experimental design: Test 174: 14 entries in one-row plots with 5 replications, plot rows 53' long.
Test 274: 14 entries in one-row plots with 4 replications, plot rows 53' long.
Test 474: 120 entries in one-row plots with 2 replications, plot rows 32' long.

Test 574: 120 entries in one-row plots with 4 replications, plot rows 32' long. Replications were split into 4 blocks of 30 entries each. This provided a homogeneous grouping of lines and permitted analysis of each group separately.
Test 674: 30 entries in one-row plots with 5 replications, plot rows 53' long.
Test 774: 6 entries in two-row plots with 10 replications, plot rows 53' long.
Test 874: 18 entries in split-plot design, with two-row plots and with 7 replications, plot rows 37' long. Virus treatments were main plots.
Test 974: 24 entries in split-plot design with one-row plots and with 7 replications, plot rows 37' long.
Test 1074: 26 entries in split-plot design with one-row plots and with 7 replications, plot rows 37' long.
Test 1174: 14 entries in split-plot design with one-row plots and with 7 replications, plot rows 37' long.
Test 1274: 24 entries in split-plot design with one-row plots and with 7 replications, plot rows 37' long.
Test 1374: 4 entries in split-plot design with two-row plots and with 8 replications, plot rows 25' long.
Test 1474: 25 entries in a 5x5 balanced lattice design with two-row plots and with 6 replications, plot rows 53' long.
Test 1574: 8 entries in one-row plots with 10 replications, plot rows 53' long.
Tests 1674-1, 1674-2, and 1674-3 were progeny tests each with 5 to 7 subtests. Each subtest had 18 entries in one-row plots with 4 replications, plot rows 20' long.
Test 1774: 24 entries in split-plot design with one-row plots and with 7 replications, plot rows 37' long.
Test 1874: 16 entries in split-block design with one-row plots and with 10 replications, plot rows 25' long.
Test 1974: 7 entries in one-row plots with 10 replications, plot rows 53' long.
Test 2074: 64 entries in one-row plots with 2 replications, plot rows 53' long.

Sugar analysis: Determined from one or two samples per plot of approximately 10 roots each at the sugar analytical laboratory, U.S. Agricultural Research Station, Salinas, California.

Remarks: The assistance of Dr. F. J. Hills and Ms. Patricia Thomas, University of California at Davis in the analysis of test data is gratefully acknowledged.

YIELD PERFORMANCE AND YELLOWS EVALUATION TRIALS, SALINAS, CALIFORNIA, 1974

Tests 874, 974, 1074, 1174, 1274, 1374, and 1774

These tests were designed to obtain information on the performance of experimental hybrids, breeding lines, accessions, etc., under both relatively free and severe virus yellows infected conditions and to obtain an estimate of their relative resistance or tolerance level. Each of these tests was a split-plot design with inoculated and noninoculated treatments as the main plots. Viruliferous green peach aphids carrying both BYV and BWYV were used as inoculum. A severe, vein-clearing strain of BYV was used. An uncharacterized mixture of BWYV isolates designated C71 was used.

Both spray applications of Meta-Systox R and sidedress applications of Temik 10G were used to control aphids and help prevent secondary spread of these viruses. However, after mid-August, secondary virus infection became fairly general in all tests except 1774.

Most of the pertinent performance and yellows evaluation data are summarized in tables for tests 874, 974, 1074, 1174, 1274, 1374, and 1774. A few general and specific details and observations are also given below.

Yellows evaluation--Virus yellows reaction was measured by the percentage loss between noninoculated and inoculated plots. For every entry in every test, yellows inoculation caused a significant sugar yield reduction. In tests with divergent entries, significant variety x virus treatment interactions occurred. These interactions indicated that the virus treatments were causing differential effects between some varieties.

The differences between the performance of yellows inoculated and noninoculated treatments show that even within the most resistant hybrids and breeding lines severe yellows infection causes economically important losses. Because varietal resistance cannot completely prevent these losses, the appropriate cultural practices of field sanitation and beet free periods are still important.

The actual losses due to yellows are probably even greater than demonstrated by these tests. In test 1374 sufficient spread of yellows had occurred to negate any measurable differences between the August 13 inoculation and the noninoculated checks. A second consideration in the interpretation of these results is that the range of the percent loss values between the moderately resistant and the susceptible entries is reduced due to yellows infection in the noninoculated checks. Therefore, the full extent of differences between virus treatments was not realized, and this unrealized difference would be relatively greater for the more susceptible entries.

Root rot--At harvest, roots showing any signs of rot were counted. Most of this rot appeared to be due to Erwinia. Although the percentage of roots with rot is fairly low, these values are fairly indicative of the range of varietal reactions to Erwinia as measured in Erwinia inoculated tests. In general, a higher percentage of roots showed rotting in the noninoculated plots.

Powdery mildew--During early July, powdery mildew reached epiphytotic conditions in all of these tests. Because the importance of mildew was not appreciated, control measures were not attempted. However, now there is evidence that mildew was probably causing 30 to 40% reduction in sugar yield in susceptible varieties.

Most of the entries in these tests were similar in their reaction to powdery mildew and were nearly equivalent to the moderately susceptible reaction of US H10B. However, some range in severity was observed, for example, US H7A and F66-64 were less severely infected than US H10B and C17 and hybrid S72-320 in test 1274 had moderate resistance. Differences in severity were most evident during the early stages of infection. It is not known what differential effects these differences in reaction had on the final yield data.

In general, powdery mildew appeared to be more severe on the yellows inoculated plots. It is not known how this influenced the percent loss data. There is some question, however, whether this difference is real in terms of disease damage or just a visual difference due to the influence of yellows infection on the structure of the canopy.

For test 1774 in which a divergent set of lines was tested, a wide range in mildew reactions was evident. These lines were scored for mildew reaction on a scale of 0 = immune to 9 = 100% severity. The mean varietal scores ranged from 4.0 to 8.5. Within most of these lines, individual plants also showed a range of reaction types. The range of reactions between and within these sugarbeet lines suggested that genetic variability exists for powdery mildew resistance and that this resistance could probably be capitalized in a breeding program. In general, the lines and hybrids derived from the California curly top and yellows resistance programs are quite susceptible. However, lines from Europe, e.g., 3204, 3205, Maris Vanguard, and Bush Mono, where breeding plots have been exposed to powdery mildew, possess moderate resistance. SP6822-0 from Beltsville also had moderate resistance. The F_3 lines Y338, Y334, and Y335 from crosses between susceptible 813 and moderately resistant SP6822-0, FC 701/2, and FC 702/2, respectively, had mildew scores approximately midway between the reactions of their respective parents.

In test 1774, the yellows inoculated plots had a significantly higher score (6.9) than the noninoculated plots (6.2). A highly significant interaction for mildew scores also occurred for the variety x virus treatments. Generally, there was a greater difference between the

mildew scores for lines with moderate mildew resistance than between mildew susceptible lines. Three sets of simple correlation coefficients were calculated between the mildew scores and sugar yield, beet yield, and % sucrose. For all plots in test 1774, these coefficients were: r = -0.40; -0.43; and -0.16. For just the noninoculated plots, the values were: r = -0.56; -0.59; and -0.0. For just the yellows inoculated plots, the values were: r = -0.06; -0.09; 0.09. These negative correlations suggest that in this test, the final yield was partially dependent upon the severity of mildew infection, particularly for the noninoculated treatment.

YELLOWS AND COMBINING ABILITY EVALUATIONS OF 773 POPULATIONS, 1974

Test 1174

Mass selection has been the primary method used at Salinas to select for yellows resistance and concurrently for root yield and sucrose concentration. This program has been moderately successful in self-sterile lines as shown by the yellows resistance and combining ability of such lines as C13, C17, C01, etc. However, the efficacy of mass selection for obtaining yellows resistance within self-fertile lines has been meager. This test summarizes the results of one cycle of half-sib selection for yellows resistance, sugar yield, and sugar concentration within a self-fertile population.

A composite cross designated 773 was used as the base population. This population was developed from a range of self-fertile breeding lines tracing their histories back to the California curly-top resistance program and to crosses with recent European introductions. Plants segregating for Mendelian male sterility within several of these lines were used as the initial females. In subsequent increases, this male sterility was used as the emasculating agent to insure obtaining complete outcrossing rather than selfing. In each increase after the F_1, seed was harvested only from the Mendelian male-sterile segregates until the population segregated approximately 50% for male sterility.

From an isolation plot grown in 1971, seed (designated as 1773) was harvested from individual male-sterile plants. The seed from 48 of these half-sib families was grown in a randomized complete-block test in 1972 (see page B24, Sugarbeet Research, 1972). The entries in this test were uniformly inoculated with a combination of BYV and BWYV. These yellows infected families were evaluated for gross sugar and root yield and sucrose concentration.

Four seed isolation plots were grown in 1973 using stecklings produced from remnant seed of the half-sib families. For each plot stecklings from four families were combined. The four 3773 populations were derived from families that had (1) the highest gross sugar yield (HGS), (2) the lowest gross sugar yield (LGS), (3) the highest sucrose concentration (HS), and (4) the lowest sucrose concentration (LS). Seed

in each plot was harvested only from male sterile plants. In addition, stecklings of 546H3 were planted in each plot to obtain hybrid seed.

These 3773 populations and hybrids were tested for yellows resistance and yield performance in 1974. An unselected increase of the original 1773 population (2773) and its hybrid with 546H3 were used as checks. In addition, a population derived by mass selection from space planted, yellows infected plants of 1773 and its hybrid with 546H3 were included. An increase of C17 and the commercial hybrid US H10B were used as yellows resistant checks.

Yellows resistance--The primary purpose of this experiment was to determine if progeny testing could be used to identify segregates with high and low yellows resistance. It would be desirable if yellows resistant, self-fertile, broadbase populations could be developed from which inbred lines with yellows resistance and combining ability could be isolated or for which genetic variability still existed for other types of selection.

After one cycle of selection and evaluation, the results are not conclusive. As judged by the percent loss data for gross sugar, yellows resistance was increased, but not significantly, by selecting the families with the highest gross sugar and the highest sucrose percentage. The one cycle of mass selection, however, was equally effective at decreasing loss due to yellows. Selecting the families with the lowest gross sugar and sucrose percentage did not increase the loss due to yellows.

Combining ability--The field test of the half-sib families should have provided an evaluation of general combining ability. If the heritabilities for general combining ability are sufficiently high, then with half-sib evaluation, it should be possible to develop populations with higher general combining ability than that expressed by the original population.

Within the 773 populations per se, selection for high gross sugar did not significantly increase sugar yield in the noninoculated treatment but did in the yellows inoculated treatment. Selections for low sugar yield and sucrose concentration significantly decreased sugar yield in both the inoculated and noninoculated treatments as compared to the unselected 2773 population. None of the selected populations showed a significant change for gross sugar yield when tested for combining ability with 546H3.

Sucrose concentration appeared to be more amenable to divergent selection than root yield. In the 773 populations per se, the high sugar selection had significantly higher sucrose than the nonselected check under both noninoculated and yellows infected treatments. This prepotency for sucrose concentration was also expressed in the hybrids with 546H3.

EVALUATION OF BEET MOSAIC VIRUS RESISTANT-SUSCEPTIBLE NEAR-ISOGENIC LINES, 1974

Test 1874

The purpose of this test was to compare seven pairs of near-isogenic lines under four virus infection treatments: (1) noninoculated check, (2) beet mosaic virus (BMV), (3) beet yellows virus (BYV), and (4) beet western yellows virus (BWYV). The near-isogenic pairs are differentiated by the presence of either the Bm allele (BMV resistant) or the bm allele (BMV susceptible).

In the greenhouse, the Bm allele conditions a high level of BMV resistance as measured by systemic symptoms and virus titer. However, the protection against yield loss, provided by this allele toward BMV infection has not previously been examined. In California, because sugarbeet plants are often multiple infected with BMV, BYV, and BWYV, it was of interest to determine the specificity of the Bm allele toward BYV and BWYV.

The Bm allele was backcrossed into seven open-pollinated breeding lines with variable virus yellows resistance. After each of the three consecutive backcrosses, the resistant segregates were identified by foliar symptoms and selected. The heterozygous resistant plants selected after the final backcross were increased in isolation. The resultant F_2B_3 progeny segregated 1 BmBm:2 Bmbm:1 bmbm. The incompletely dominant heterozygotes were discarded and the BmBm and bmbm plants were selected and increased in separate isolations to develop the near isogenic pairs. Theoretically, these lines should have about 94% of the genetic makeup of their recurrent parents.

The seven pairs of near isogenics were grown in a split-block design with 10 replications. Each replication was randomly divided into four strips with each strip being used for one of the virus treatments. Separate inoculations with BYV and BWYV were made using aphid vectors. Mechanical inoculation was used with BMV. The BMV inoculum was obtained from a naturally infected sugarbeet field near Byron, California.

Temik was sidedressed across all plots after thinning and again just prior to the BYV and BWYV inoculations.

Within each of the seven pairs of isogenic lines, agronomic characteristics were very similar. The BMV, BYV, and BWYV inoculations appeared to cause about 100% infection. Nearly all of the plants of the BMV inoculated bmbm lines developed typical symptoms whereas very few of the plants in the BmBm lines developed distinct mosaic symptoms. After early September, general spread of the three viruses was observed. Powdery mildew infection started about August 1, but control was not attempted until wettable sulfur was applied in mid-September.

Beet mosaic virus--When inoculated with BMV, the BmBm isogenic member of each pair had higher sugar and beet yield than the bmbm member. For sugar yield, losses within the BmBm lines varied from 0 to 4.6%. Within the bmbm lines, losses varied from 8 to 27.6%. The Bm allele, then, does condition protection against yield loss under BMV infected conditions.

In addition to the BMV resistance derived from the Bm allele, there is probably a quantitatively inherited background resistance to BMV. In the greenhouse, yellows resistant lines usually have less severe symptoms than yellows susceptible lines. This greenhouse observation is supported by this field trial. In general, lines with yellows resistance, e.g., C17 and C10, did not have as great a loss due to BMV infection as did the yellows susceptible lines, e.g., C21 and 9101.

Noninoculated check--The differences between the combined BmBm lines and the bmbm lines were not significantly different for sugar and beet yield. However, significant differences did occur within some of the specific pairs.

For sucrose, every bmbm member of a pair had a higher concentration than the BmBm member and four out of seven pairs were significantly different. These differences were even more evident when the bmbm and BmBm members were infected with BYV or BWYV. These data suggest that a relationship exists between the allele for mosaic resistance and sucrose concentration. This relationship might be interpreted as: (1) pleiotropy between the Bm allele and reduced sucrose concentration; or (2) as linkage between the bm locus and factor(s) for sucrose concentration. If these correlated effects are due to linkage, then the factor(s) for higher sucrose concentration are apparently in the repulsion phase with the Bm allele. It may be speculated that either a single sucrose factor or a tightly linked "block" of sucrose factors are involved in this relationship.

Beet yellows and beet western yellows viruses--The data for sugar yield and sucrose suggest that the Bm gene specifically conditions resistance to BMV and not to BYV or BWYV. In fact, there is a trend for the bmbm lines to be more resistant to yield loss due to BYV and BWYV infection than the BmBm lines. Particularly under BWYV infected conditions, sugar yield losses fell into two categories with respect to individual comparisons between the seven pairs of isogenic lines. Those BmBm members derived from lines with known yellows resistance, i.e., C01, C04, C17, C10, and C44, had higher relative losses due to BWYV infection than the bmbm members. However, the BmBm members derived from lines with known yellows susceptibility, i.e., C21 and 9101, had lower relative losses due to BWYV infection than the bmbm member. Symptoms to BYV infection also suggested that yellows resistance was decreased by the transfer of the Bm allele into C17. After 5 weeks of infection, whereas 813 and F_3B_3C17bmbm were essentially symptomless, the F_3B_3 C17BmBm line had symptoms equal to a yellows susceptible line, e.g., C21. Again, these correlated relationships might indicate that some factor(s) that condition yellows reaction are linked with the Bm locus.

This test also gives good information on the relative importance and effects of BYV and BWYV epiphytotics. Sugar yield losses varied from 15.2 to 48.5% due to BYV and from 5.5 to 23.7% due to BWYV. BWYV infection caused a reduction in sucrose concentration nearly equal to that caused by BYV. In fact, it appears that resistance to BWYV is an important component of the total yellows resistance found in lines such as C17 and C04.

Powdery mildew--In comparison with the noninoculated treatment, powdery mildew scores for the BYV and BWYV infected treatments were significantly higher. It is not known whether this difference is real in terms of disease damage or due to canopy differences between healthy and yellows infected plants.

Root rot--This test was grown contiguously to the Erwinia root rot trials and some natural spread of Erwinia occurred. The BWYV treatment had a higher percentage and the BMV and BYV treatments had lower percentages of Erwinia infection than the noninoculated check. Rot was significantly less in the BYV plots. The presence of the Bm allele did not significantly change a line's reaction to Erwinia.

AN UNSUCCESSFUL ATTEMPT TO TRANSMIT THE FACTOR FOR CMS THROUGH POLLEN

R. T. Lewellen

Occasionally cytoplasmic-male-sterile plants will inexplicably appear in our breeding lines. In cases where mechanical mixtures and other causes generally can be ruled out, it might be speculated that these steriles resulted from the transmission of the male-sterility factor through the male from partially fertile or restored plants to plants with normal cytoplasm.

To test this possibility, partially restored plants were crossed to self-sterile, O-type plants with normal cytoplasm. Paired plants were placed under a pollen-tight bag in the greenhouse and frequently agitated to disperse pollen. In the greenhouse at Salinas, very rarely is seed set by selfing on self-sterile plants and none was set by individually bagged check plants of 21 or 85. The seed set on the O-type plants were harvested and planted in Oregon to produce stecklings. In the spring of 1974, these stecklings were transplanted to the field at Salinas and examined for pollen production. The results are shown below.

O-type Female	Partially Fertile Male	Number of F_1 Plants with Full Fertility	Number of F_1 Plants with Partial or Male Sterility
21		16	0
21	x (546H3CMS x C17)	49	0
21	x (760H33CMS x Y04)	39	0
21	x (569H3CMS x 868)	7	0
85		12	0
85CMS		0	38
85	x (546H3CMS x C17)	98	0
85	x (760H33CMS x Y04)	29	0
85	x (569H3CMS x 868)	27	0

If the factor for sterile cytoplasm had been transferred from the male, the F_1 plants should have segregated for either full sterility or partial fertility. However, all F_1 plants were fully fertile and equal to the fertility of the O-type 21 and 85 lines.

These relative low numbers of test plants do not prove that the factor for CMS cannot be transferred through the male, but if it is, it is done so in a low frequency.

After the initiation of this experiment, a paper was published by Hornsey. Because his paper dealt with nearly the identical problem and reached the same conclusion, further work on this problem has been discontinued.

Hornsey, K. G. 1973. Attempted pollen-transmission of cytoplasmic male sterility and the spontaneous occurrence of male sterility in O-type lines of sugar beet (Beta vulgaris L.). Theoretical and Applied Genetics 43: 31-34.

TEST 474. BOLTING EVALUATION TEST, SALINAS, CALIFORNIA, 1973-4

2 replications
1-row plots, 32 ft. long — Planted: December 18, 1973

Variety	Description	7/19 Bolting	9/4 Bolting	Powdery Mildew 9/4
		Percent	Percent	Score[1/]
1502 (Sp.)	Inc. 0502	47.3	54.1	7.5
1502H0 (Sp.)	0502H0 x 0502	35.7	44.3	7.0
2502H0	1502H0A x 0502	2.8	7.0	7.5
3502	Inc. 1502 (Iso.)	0.0	2.2	7.0
3502Aa	2502aa x 1502 (Iso.)	1.1	1.1	6.5
3592	Inc. 4592	20.2	21.0	6.5
2512	Inc. S_{13}(US 22/3 x 4200-14)	0.0	0.0	6.5
2547	Inc.[S_{16} (759-25 x 759-100) x S_1(759-25 x B1-4)]	0.0	0.0	4.0
2554 (Iso.)	Inc. S_{13}(1-11 x 1-716-1)	0.0	0.0	5.0
2562	Inc. S_{11}(4502 x 4570-49-12)	40.5	66.0	8.0
F66-562H0	562H0 x 562 (Kreft)	34.1	39.8	7.5
F67-564	Inc. 5564	55.8	67.4	8.0
F67-564H0	5564H0 x 5564	35.7	37.5	7.0
1565	Inc. C9564	40.5	48.1	8.0
3565	Inc. 1565	25.3	43.0	8.0
1565H0	F68-564H0 x C9564	36.8	49.1	7.5
3565H0	F67-564H0 x 1565	15.4	26.9	8.0
2522-29	Inc. 8522-29C2	15.9	28.0	7.0
3522-25	Inc. 1522-25	0.0	6.2	7.0
3522-25H0	1522-25H0 x 1522-25	7.4	13.2	7.5
3536-97	Inc. 8536-97C2rr	2.1	2.1	5.0
3536-97H0	1536H0 x 8536-97C2rr	5.8	9.3	7.0
2522-29H21	1536H0 x 8522-29C2	30.6	38.9	7.5
2522-29H23	0522H52 x 8522-29C2	8.6	20.0	8.0
3522-25H85	1536H61 x 1522-25	12.5	15.0	7.0
3536-97H3	F66-562H0 x 8536-97C2rr	5.1	9.0	7.0
3536-97H23	1522H52 x 8536-97C2rr	5.6	15.5	7.0
3536-97H54	2705H0 x 8536-97C2rr	0.0	1.3	7.5
3536-97H72	2718H0 x 8536-97C2rr	1.4	1.4	7.0
3565H54	2705H0 x 1565	3.6	13.1	6.0
3565H72	2718H0 x 1565	13.0	29.6	6.5
3546H72A	1718H0 x F70-546	5.4	6.8	6.0
3705H72A	1718H0 x 2705	0.0	0.0	6.0
1705H72	9718H0 x 9705	5.2	10.4	5.5
1718H5	F68-564H0 x 9718	9.7	12.9	7.0
1718H54	0705H0A x 9718	14.9	20.3	6.5
1718H52	8522H1 x 9718	4.8	13.1	7.0
2718H54	1705H0 x 1718	5.6	12.2	6.0
1724H72	9718H0 x 9724	15.1	17.4	6.5
F70-546	Inc. F63-546	8.1	10.8	6.0

1/ Powdery mildew was scored on a scale of 0 to 9 where 0 = no evidence of infection to 9 = a severity of 100%.

TEST 474. BOLTING EVALUATION TEST, SALINAS, CALIFORNIA, 1973-4 cont'd.

Variety	Description	7/19 Bolting	9/4 Bolting	Powdery Mildew 9/4
		Percent	Percent	Score[1/]
3546	Inc. F70-546	6.7	6.7	6.0
2705	BRS 0705	3.8	5.1	6.5
2705H0	BRS 0705H0 x BRS 0705	2.3	4.8	6.0
3705	Inc. 2705	2.2	5.4	6.5
3705H0	2705H0 x 2705	2.4	8.5	6.0
3511	Inc. 8511	8.1	17.7	7.0
2718	Inc. 1718	8.5	12.7	6.0
2718H0	1718H0 x 1718	2.4	2.4	6.5
3718 (Sp.)	Inc. 1718, 2718	5.5	8.2	6.5
3718H0A (Sp.)	1718H0 x 1718, 2718	3.4	9.1	7.0
3718H0B (Sp.)	2718H0 x 1718, 2718	4.6	8.0	7.0
3718 (Iso.)	Inc. 1718	0.0	0.0	6.5
3718H0 (Iso.)	2718H0 x 1718	0.0	1.3	7.0
3718 (Ore.)	Inc. 1718	3.6	3.6	6.5
3718H0A (Ore.)	1718H0 x 1718	0.0	5.2	7.0
3718H0B (Ore.)	2718H0 x 1718	0.0	0.0	6.5
3718H3 (Ore.)	F66-562H0 x 1718	5.8	13.0	7.0
7716H0	6716H0 x 6716	0.0	1.2	5.5
3755	2755mm⊗	15.1	17.8	6.0
3791C1	2791mm⊗	10.6	14.1	6.5
3770	2770Bmm⊗	11.1	11.1	3.5
3771	2771Bmm⊗	9.3	10.7	6.0
3774	2774Bmm⊗	19.1	22.1	7.0
3737	0737mm⊗	0.0	14.3	6.0
3738	9738mm⊗	5.8	5.8	6.0
3738A	2738mm⊗	10.0	30.0	6.0
3739	9739mm⊗	3.9	7.8	6.0
3761-1	YRS S_2(13 x 7522)mm	5.1	7.1	6.5
3761-2	YRS S_2(13 x 7534)mm	4.1	4.1	6.0
3761-3	YRS S_2(13 x 8536)mm	4.5	6.8	6.0
3761-4	YRS S_2(13 x 7601)mm	39.2	46.8	6.5
3761-5	YRS S_2(13 x 6532)mm	0.0	4.5	6.0
3761-6	YRS S_2(13 x 7564)mm	0.0	0.0	6.0
3762-1	YRS S_2(Y04 x 7522)mm	8.9	12.7	7.0
3762-2	YRS S_2(Y04 x 7534)mm	16.0	18.7	5.5
3762-3	YRS S_2(Y04 x 7536)mm	32.2	44.8	7.0
3762-4	YRS S_2(Y04 x 6562)mm	0.0	0.0	6.0
3762-5	YRS S_2(Y04 x 7564)mm	4.4	5.6	7.0
3762-6	YRS S_2(Y04 x 6563)mm	28.6	28.6	6.5
3762-7	YRS S_2(Y04 x 7823)mm	7.8	8.9	7.0

1/ Powdery mildew was scored on a scale of 0 to 9 where 0 = no evidence of infection to 9 = a severity of 100%.

TEST 474. BOLTING EVALUATION TEST, SALINAS, CALIFORNIA, 1973-4 cont'd.

Variety	Description	7/19 Bolting	9/4 Bolting	Powdery Mildew 9/4
		Percent	Percent	Score[1/]
3763-1	YRS S_2(Y01 x 7564)mm	0.0	2.6	6.5
3763-2	YRS S_2(Y01 x 7823)mm	6.0	8.3	6.0
3763-4	YRS S_2(Y01 x 8699)mm	1.3	4.0	7.0
3763-5	YRS S_2(10 x 6563)mm	6.6	20.9	7.0
3765-1A	Inc. S_2(7522 x 7760)mm	11.0	12.2	7.5
3765-2	YRS S_2(7534 x 7760)mm	38.5	43.6	7.0
3765-3	YRS S_2(7536 x 7760)mm	18.8	18.8	5.5
3765-4	YRS S_2(7601 x 7760)mm	41.5	49.2	6.5
3765-5	YRS S_2(8699 x 7760)mm	6.3	12.5	5.5
3765-6	YRS S_2(6707 x 7760)mm	0.0	1.4	5.0
3766-1	YRS S_2(7534 x 7757)mm	10.5	11.8	6.5
3766-3	YRS S_2(7823 x 7757)mm	23.0	26.4	6.5
3767-2	YRS S_2(6532 x 7734)mm	2.4	3.6	7.0
3768-1	YRS S_2(6532 x 7716)mm	1.3	1.3	6.5
3209	BMRS F_3B_3 Y01	27.8	36.1	6.0
3210	BMSS F_3B_3 Y01	19.2	28.2	5.5
3211	BMRS F_3B_3 Y04	36.6	43.4	6.0
3212	BMSS F3B3 Y04	5.7	14.9	6.0
3213	BMRS F_3B_3 13	24.0	29.3	6.0
3214	BMSS F_3B_3 13	16.0	18.7	6.0
3215	BMRS F_3B_3 10	8.7	8.7	6.5
3216	BMSS F_3B_3 10	1.3	6.3	6.0
3217	BMRS F_3B_3 21	27.6	29.9	5.5
3218	BMSS F_3B_3 21	29.5	37.5	6.0
3219	BMRS F_3B_3 44	1.3	5.1	6.0
3220	BMSS F_3B_3 44	2.4	3.7	6.0
3223	BMRS F_3B_3 60	7.7	14.1	8.0
3224	BMSS F_3B_3 60	2.4	6.0	7.0
3225	BMRS F_3B_3 61	50.0	53.8	7.0
3226	BMSS F_3B_3 61	7.4	11.1	5.5
3227	BMRS F_3B_3 9101	11.5	14.9	5.5
3228	BMSS F_3B_3 9101	4.5	10.1	5.5
3252	813 x 2207RY	2.1	3.2	5.5
3253	813 x 2209RY	12.8	17.0	6.0
3255	Y201 x F66-64	5.5	8.8	5.5
SP7134-00	From Coe	20.0	33.7	5.5

1/ Powdery mildew was scored on a scale of 0 to 9 where 0 = no evidence of infection to 9 = a severity of 100%.

TEST 574. BOLTING EVALUATION TEST, SALINAS, CALIFORNIA, 1973-4

4 replications
1-row plots, 32 ft. long

Planted: December 18, 1973
Harvested: September 9-11, 1974

Variety	Description	Acre Yield Sugar Pounds	Acre Yield Beets Tons	Sucrose Percent	7/19 Bolting Percent	9/4 Bolting Percent	Root Rot Percent	Beets/ 100' Number
Y301H52	8522H1 x Y201	11,910	40.47	14.7	1.9	5.7	3.1	123
Y301H82	2718H54 x Y201	11,880	39.52	15.1	8.2	12.3	1.8	134
Y301H81	1718H52 x Y201	11,760	38.95	15.1	3.2	7.4	3.1	127
Y331H82	2718H54 x Y231	11,250	38.26	14.7	2.9	5.4	2.9	131
Y301H62	8536H1 x Y201	11,130	38.07	14.6	5.1	11.6	3.0	130
364H82	2718H84 x F66-64	10,850	36.93	14.7	1.7	2.9	1.7	134
Y301H87	2718H84 x Y201	10,830	37.12	14.6	6.6	8.5	1.3	128
317H81	1718H52 x 813	10,830	38.00	14.3	0.6	1.3	6.6	130
Y335H8	F69-546H3 x Y235	10,780	37.94	14.2	15.5	19.6	2.9	139
317H82	2718H54 x 813	10,590	36.99	14.3	1.3	3.8	3.2	123
Y322H82	2718H54 x Y222A	10,480	36.42	14.4	5.9	9.8	5.9	122
Y204H82	1718H54 x Y104A,B	10,460	36.17	14.4	4.2	6.0	4.2	129
317H87	2718H84 x 813	10,340	35.91	14.4	0.0	0.6	1.2	132
Y336H8	F69-546H3 x Y236,7	10,320	36.42	14.2	11.4	20.4	4.4	137
Y332H82	2718H54 x Y232	10,250	35.79	14.3	0.7	0.7	2.9	133
317H78	1705H62 x 813	10,030	35.22	14.3	2.3	3.4	3.4	130
Y334H8	F69-546H3 x Y234	9,720	33.00	14.8	7.4	13.9	1.2	129
Y332H78	1705H62 x Y232	9,680	34.33	14.1	2.9	4.0	5.2	138
Y329/1H78	1705H62 x Y229/1	9,410	32.62	14.4	5.6	5.6	4.2	129
3791H8	546H3 x 2791Ma	9,280	31.80	14.6	3.6	7.3	4.1	126
Y338H8	F69-546H3 x Y238	9,110	32.05	14.2	20.9	29.9	2.3	138
3791H80	2718H5 x 2791Ma	9,000	31.23	14.4	9.0	10.4	5.8	123
Mean		10,449	36.01	14.49	5.5	8.7	3.4	130
LSD (.05)		1,038	3.91	NS	5.3	6.7	NS	NS
Coefficient of Variation (%)		7.1	7.8	3.4	76.4	60.9	108.1	7.5
F value		4.2**	2.9**	NS	6.0**	7.3**	NS	NS

TEST 574. BOLTING EVALUATION TEST, SALINAS, CALIFORNIA, 1973-4 continued

Variety	Description	Acre Yield Sugar	Acre Yield Beets	Sucrose	7/19 Bolting	9/4 Bolting	Root Rot	Beets/ 100'
		Pounds	Tons	Percent	Percent	Percent	Percent	Number
317H8 (Sp.)	F70-546H3 x 813	12,120	41.80	14.5	2.1	3.7	3.2	148
223-1H8	F70-546H3 x 123-1	12,040	41.99	14.3	4.1	5.0	2.1	145
323-2H8	F70-546H3 x 123-2, 223-2	11,760	41.11	14.3	3.9	6.1	5.2	138
223-2H8	F70-546H3 x 123-2	11,340	40.73	13.9	1.0	2.3	4.2	139
323-3H8	F70-546H3 x 123-3, 223-3	11,210	40.09	14.0	3.3	5.7	3.5	137
217H8 (Sp.)	F70-546H3 x 813	11,110	39.27	14.2	0.7	1.2	6.1	127
323-1H8	F70-546H3 x 123-1, 223-1	10,780	38.07	14.1	5.8	8.3	2.3	135
117H8 (Sp.)	F69-546H3 x 813	10,650	37.37	14.3	2.4	2.9	2.3	131
223-3H8	F70-546H3 x 123-3	10,590	38.19	13.9	2.6	4.8	2.4	144
323-1	Inc. 123-1, 223-1	10,530	38.76	13.6	2.6	4.2	3.6	145
323-2	Inc. 123-2, 223-2	10,100	36.55	13.8	1.2	2.3	5.7	139
223-1	Inc. 123-1	9,810	36.61	13.4	3.5	5.9	8.6	131
123-2	Inc. 023-2	9,680	35.34	13.7	1.8	1.8	7.7	133
123-1	Inc. 023-1	9,640	35.85	13.4	3.1	5.1	9.2	115
323-3	Inc. 123-3, 223-3	9,480	35.91	13.2	3.9	4.5	3.6	139
216	2 I. V. Sel. 813	9,460	34.27	13.8	0.7	2.6	5.4	127
123-3	Inc. 023-3	9,360	35.09	13.4	2.9	2.9	4.8	127
217 (Sp.)	Inc. 813	9,250	33.63	13.7	1.0	4.1	3.4	142
218	2 Salt Sel. 813	9,210	31.99	14.4	5.1	6.2	4.6	139
317 (Sp.)	Inc. 813	9,200	32.24	14.3	3.4	4.3	10.5	115
868	Inc. F57-68 (US 75)	9,090	32.56	14.0	6.1	12.2	3.1	130
223-2	Inc. 123-2	8,940	33.82	13.3	4.0	6.3	4.2	138
F70-17	Inc. C813 (813 Ore.)	8,740	30.78	14.3	1.6	2.8	10.6	116
Y227	Inc. Y127	8,650	31.48	13.8	1.3	2.5	5.7	127
223-3	Inc. 123-3	8,650	32.68	13.2	7.4	10.3	6.8	123
F70-13 (413)	Inc. F66-13	8,580	32.37	13.3	2.9	6.5	8.9	121
813 (Ore.)	Inc. 713A	8,580	31.10	13.8	0.6	2.4	8.9	125
F71-17	Inc. F70-17	8,530	30.91	13.8	1.3	1.3	4.7	131
117 (Sp.)	Inc. 813	8,340	30.09	13.8	4.8	4.8	10.1	115
413C	Inc. 313	7,400	27.74	13.3	4.5	5.4	8.0	99
Mean		9,760	35.28	13.83	3.0	4.6	5.6	131
LSD (.05)		1,037	3.70	0.66	3.5	4.8	NS	16.2
Coefficient of Variation (%)		7.6	7.5	3.4	82.5	74.4	76.4	8.8
F value		10.7**	8.6**	2.8**	2.0**	2.1**	NS	3.8**

TEST 574. BOLTING EVALUATION TEST, SALINAS, CALIFORNIA, 1973-4 continued

Variety	Description	Acre Yield Sugar Pounds	Acre Yield Beets Tons	Sucrose Percent	7/19 Bolting Percent	9/4 Bolting Percent	Root Rot Percent	Beets/ 100' Number
Y319	Inc. Y119 (T-0 Y03)	11,290	37.18	15.2	0.0	0.0	2.0	114
Y318	Inc. Y118 (T-0 Y04)	11,130	41.49	13.4	0.0	1.7	6.9	135
Y320	Inc. Y120 (T-0 10)	11,090	40.41	13.7	0.0	0.0	1.0	140
US H10B	546H3 x F70-17 (1068)	11,050	38.13	14.5	3.9	4.9	1.8	140
364	Inc. F66-64	10,950	37.50	14.6	2.5	5.0	1.9	124
Y331	Inc. Y231	10,630	35.85	14.8	1.3	3.8	3.5	117
F66-64	Inc. 264	10,610	36.67	14.5	2.4	4.6	0.7	133
Y204	Inc. Y104A,B	10,080	35.85	14.1	8.5	14.2	5.9	120
Y301	Inc. Y201	9,990	33.63	14.9	12.8	17.0	2.8	115
Y339	Composite	9,880	35.34	14.0	14.5	18.4	1.7	127
RR84	Erwinia R.S. F70-413	9,740	33.76	14.5	0.6	1.8	4.9	128
Y334	Inc. Y234-1,2	9,690	33.82	14.3	16.0	23.8	3.0	123
Y329/1	Inc. Y229/1	9,100	30.97	14.7	3.5	4.1	7.9	118
Y322	Inc. Y222A	9,090	32.94	13.8	3.8	7.0	7.7	111
3207	Inc. Acc. 129 (Cleij)	8,970	32.43	13.9	0.6	2.5	3.2	124
RR8	Erwinia R.S. F70-413	8,860	32.62	13.6	1.7	2.2	11.3	135
Y333	Inc. Y233	8,680	31.73	13.7	1.3	1.9	5.4	122
Y332	Inc. Y232	8,560	31.29	13.7	2.1	2.1	5.7	109
Y336	Inc. Y236,7	8,530	30.47	14.0	22.5	27.9	2.0	115
Y328	Inc. Y128	8,530	29.39	14.5	1.7	1.7	3.1	128
Y335	Inc. Y235	8,270	30.28	13.7	31.4	39.9	2.7	113
3205	Inc. Acc. 127 (Cleij)	8,120	32.30	12.6	58.1	74.4	1.2	135
Y338	Inc. Y238	8,030	29.96	13.4	45.1	48.3	3.1	130
Y317	Inc. Y117 (T-0 13)	8,000	28.38	14.1	1.4	2.0	16.0	109
317T	Inc. 117T	7,980	28.88	13.9	0.7	2.0	22.6	107
3206	Inc. Acc. 128 (Cleij)	7,710	27.05	14.3	10.2	15.9	7.5	122
3201	F_2B_2(868 x Red)	7,360	27.43	13.4	2.5	5.2	0.0	128
3204	Inc. Acc. 125 (Cleij)	6,800	24.13	14.1	44.9	65.8	1.1	134
FC 702/2	From Ft. Collins	5,330	19.57	13.6	66.3	78.5	0.0	108
SP6822-0(B)	From Coe	5,080	19.51	13.1	71.2	79.9	0.9	107
Mean		8,972	31.97	14.01	14.4	18.5	4.6	122
LSD (.05)		968	3.56	0.61	8.2	6.7	6.3	18.4
Coefficient of Variation (%)		7.7	7.9	3.1	40.4	25.8	97.3	10.7
F value		21.7**	17.0**	6.9**	53.4**	112.1**	4.9**	2.4**

TEST 574. BOLTING EVALUATION TEST, SALINAS, CALIFORNIA, 1973-4 continued

Variety	Description	Acre Yield Sugar Pounds	Acre Yield Beets Tons	Sucrose Percent	7/19 Bolting Percent	9/4 Bolting Percent	Root Rot Percent	Beets/ 100' Number
2554H1	0502H0 x 0554	10,520	35.91	14.7	2.4	4.0	0.5	134
3546H72B	2718H0 x F70-546	9,660	35.54	15.4	5.6	9.5	0.0	140
3565H54	2705H0 x 1565	9,500	29.83	15.9	4.3	11.8	4.3	146
3705H72B	2718H0 x 2705	9,380	31.23	15.0	0.5	4.8	2.7	148
3546H54	2705H0 x F70-546	9,320	30.15	15.5	1.1	4.2	0.5	147
3718H54	2705H0 x 2718	9,310	30.72	15.2	3.4	6.3	2.3	148
3789H72	2718H0 x 2775,6A	9,300	30.47	15.3	3.9	6.3	2.8	138
3791	2791aa x 2791A	8,900	30.02	14.8	6.2	13.3	3.2	122
3789H3	F66-562H0 x 2775,6A	8,780	29.33	15.0	6.5	8.0	1.7	145
3705H5	F68-564H0 x 2705	8,780	28.44	15.5	5.8	7.5	1.8	135
3790H72	2718H0 x 2775-2798A	8,640	28.06	15.4	2.3	6.3	0.6	141
F70-546H3	562H0 x F63-546	8,520	28.25	15.1	4.5	7.4	0.0	136
3789	2775,6aa x A	8,420	26.92	15.6	6.7	7.3	1.1	141
3790	2775,6, 2792,3,4,5,7,8aa x A	8,320	28.38	14.7	3.2	6.5	2.7	141
3718H4	F66-563H0 x 2718	8,270	27.93	14.8	3.7	9.5	0.0	148
3536-97H54	2705H0 x 8536-97C2rr	8,200	27.17	15.1	3.6	4.6	1.6	152
3790H3	F66-562H0 x 2775-2798A	8,090	27.05	15.0	8.8	12.8	1.7	140
3718H5	F68-564H0 x 2718	7,880	26.60	14.8	11.7	16.9	3.9	140
3718H3 (Sp.)	F66-562H0 x 2718	7,880	26.29	15.0	3.3	7.3	0.6	146
3705H3	F66-562H0 x 2705	7,680	25.72	15.0	4.6	10.8	0.0	139
3536-97H3	F66-562H0 x 8536-97C2rr	7,600	25.53	14.9	4.0	7.0	3.4	138
3565H72	2718H0 x 1565	7,520	24.64	15.3	15.0	24.4	2.8	128
2718H5	F68-564H0 x 1718	7,450	25.15	14.8	12.2	26.7	1.1	135
3536-97H72	2718H0 x 8536-97C2rr	7,350	24.89	14.8	1.1	2.2	2.9	140
Mean		8,552	28.34	15.10	5.2	9.4	1.8	140
LSD (.05)		929	3.19	0.64	4.2	6.6	2.5	16.2
Coefficient of Variation (%)		7.6	7.7	3.0	62.3	54.4	113.2	8.3
F value		7.4**	7.8**	3.7**	5.6**	6.1**	2.0**	1.8*

TEST 574. BOLTING EVALUATION TEST, SALINAS, CALIFORNIA, 1973-4 continued

Variety	Description	Acre Yield Sugar Pounds	Acre Yield Beets Tons	Sucrose Percent	7/19 Bolting Percent	9/4 Bolting Percent	Root Rot Percent	Beets/ 100' Number
3773	Inc. 1773-HGS Sel.	10,780	36.04	15.0	2.6	4.0	0.6	122
3773B	Inc. 2773B (Mass Sel.)	10,300	34.96	14.7	1.2	3.0	0.6	130
3773E	Inc. 1773-LS Sel.	9,270	33.70	13.8	2.2	4.4	1.1	147
2773	Inc. 1773	9,000	30.91	14.6	10.0	13.1	0.6	136
3773C	Inc. 1773-LGS Sel.	8,990	32.18	14.0	1.0	2.1	1.7	148
3773D	Inc. 1773-HS Sel.	8,920	29.96	14.9	3.8	6.7	0.6	127
Mean		9,545	32.96	14.48	3.5	5.5	0.8	135
LSD (.05)		910	2.91	0.61	3.9	6.0	NS	11.3
Coefficient of Variation (%)		6.3	5.9	2.8	74.3	71.8	182.1	5.5
F value		7.0**	6.0**	6.0**	6.8**	4.0*	NS	8.0**
3773BH80	2718H5 x 2773B (Mass Sel.)	10,980	38.32	14.4	4.0	6.0	2.6	123
3773BH8	546H3 x 2773B (Mass Sel.)	10,580	36.29	14.5	1.7	2.8	0.6	139
3773H80	2718H5 x 1773-HGS Sel.	10,440	35.85	14.6	1.3	3.7	2.4	126
3773CH8	546H3 x 1773-LGS Sel.	10,340	35.03	14.8	3.0	5.3	1.2	130
3773DH8	546H3 x 1773-HS Sel.	10,210	33.95	15.1	3.5	5.7	0.6	136
2773H8	546H3 x 1773	10,150	34.58	14.7	6.7	12.7	0.0	130
3773EH8	546H3 x 1773-LS Sel.	10,030	34.84	14.4	5.2	7.6	0.6	151
3773H8	546H3 x 1773-HGS Sel.	9,580	32.81	14.6	1.0	2.1	0.7	133
Mean		10,287	35.21	14.63	3.3	5.8	1.1	133
LSD (.05)		NS	NS	NS	NS	NS	NS	12.4
Coefficient of Variation (%)		7.3	7.3	4.0	103.8	79.7	164.4	6.3
F value		NS	NS	NS	NS	NS	NS	4.2**

TEST 674. BOLTING EVALUATION TEST, SALINAS, CALIFORNIA, 1973-74

5 replications
1 row plots, 53 ft. long

Planted: December 14, 1973
Harvested: September 11-12, 1974

Variety	Description	Acre Yield		Sucrose	7/19	9/4	Root	Beets/
		Sugar	Beets		Bolting	Bolting	Rot	100'
		Pounds	Tons	Percent	Percent	Percent	Percent	Number
Y301H80	2718H5 x Y201	12,210	41.04	14.9	8.2	14.2	3.6	122
Y333H80	2718H5 x Y233	11,960	42.50	14.1	2.0	2.7	10.4	112
364H80	2718H5 x F66-64	11,900	40.19	14.8	5.1	5.7	1.1	132
Y331H80	2718H5 x Y231	11,710	39.78	14.8	3.3	6.2	5.7	109
364H8	F70-546H3 x F66-64	11,650	38.45	15.1	4.4	4.7	1.4	137
Y332H80	2718H5 x Y222A	11,620	40.66	14.3	2.6	6.1	6.7	118
Y331H8	F70-546H3 x Y231	11,590	38.07	15.2	5.7	8.0	1.3	122
Y329/1H80	2718H5 x Y229/1	11,550	39.81	14.5	2.6	4.1	6.0	119
Y204H8	F70-546H3 x Y104A,B	11,490	38.67	14.9	5.3	10.6	3.4	127
317H80	2718H5 x 813	11,380	39.78	14.3	2.0	3.9	5.5	129
Y301H8	F70-546H3 x Y201	11,330	37.56	15.1	9.3	15.4	0.9	126
317TH8	F70-546H3 x 117T	11,310	39.27	14.4	2.2	3.8	6.7	125
Y322H8	F69-546H3 x Y222A	11,270	37.88	14.9	4.3	7.4	5.3	122
317H52	8522H1 x 813	11,240	39.08	14.4	4.3	5.9	3.5	140
Y333H8	F69-546H3 x Y233	11,190	38.86	14.4	1.9	3.5	5.1	118
Y332H80	2718H5 x Y232	11,030	38.54	14.3	2.8	3.8	4.3	124
813H8	546H3 x 713A	11,030	38.23	14.4	3.7	6.7	5.5	137
Y227H8	F70-546H3 x Y127	10,970	38.51	14.2	5.4	8.2	1.1	140
Y332H8	F70-546H3 x Y232	10,960	37.69	14.6	2.1	3.4	0.9	124
317H8	F70-546H3 x 813	10,840	37.91	14.3	1.3	2.2	3.2	139
USH10B	546H3 x F70-17(1068)	10,840	36.93	14.7	7.8	9.9	2.3	141
Y328H8	F70-546H3 x Y128	10,800	36.55	14.8	1.1	2.9	3.2	130
U913H8	546H3 x F68-13	10,670	37.40	14.3	8.4	13.8	4.8	130
USH10A	569H3 x F70-17(1231)	10,550	36.39	14.5	7.6	9.4	1.9	142
664H8	546H3 x 64(USH7A)	10,540	35.19	15.0	7.2	12.8	1.0	119
317TH62	8536H1 x 117T	10,450	37.85	13.8	3.4	5.2	12.8	127
U913H4	569H3 x F68-13	10,430	36.42	14.3	7.1	10.4	3.0	140
Y329/1H8	F70-546H3 x Y229/1	10,420	36.07	14.5	2.2	4.9	2.8	135
317TH52	8522H1 x 117T	10,100	35.91	14.1	2.4	3.6	12.8	129
317H62	8536H1 x 813	10,020	35.47	14.1	5.6	7.9	6.2	142
Mean		11,102	38.22	14.53	4.4	6.9	4.4	129
LSD (.05)		981	3.22	0.45	3.09	3.95	4.17	13.5
Coefficient of Variation (%)		7.1	6.7	2.5	56.4	45.7	75.5	8.4
F value		2.5**	2.2**	4.6**	4.7**	6.8**	4.6**	3.7**

** Exceeds the 1% point of significance (F = 1.86).

Bolting Resistance of USH9 and USH10 Seed Lots,
Salinas, California, 1974

5 replications, Randomized Blocks
1 row plots, 53 ft. long

Planted: December 18, 1973
Counted: September 9, 1974

Lot No.	Variety	Year of Seed Prod.	Place Grown	Percent Bolters
WC9188	USH10B	1969	Salem	13.1
WC1068	USH10B	1970	Salem	5.4
WC3005	USH10B	1973	Salem	2.4
WC3018	USH10B	1973	Salem	2.3
WC3104	USH10B	1973	Salem	3.7
WC3113	USH10B	1973	Salem	3.3
WC3273	USH10B	1973	Salem	2.1
813H8	USH10B	1968	Salinas	6.1
217H8	USH10B	1972	Salinas	5.2
317H8	USH10B	1973	Salinas	3.2
WC8480	USH9A	1968	Salem	9.0
WC9162	USH9A	1969	Salem	11.3
WC8226	USH9B	1968	Salem	11.8
WC9034	USH9B	1969	Salem	15.3
Mean				6.7
LSD (.05)				3.3
Coefficient of Variation (%)				38.6
F Value				15.07**

** Exceeds the 1% point of significance (F = 2.46).

TEST 774. DIPLOID-TRIPLOID TEST, SALINAS, CALIFORNIA, 1974

10 replications
2 row plots, 53 ft. long

Planted: January 28-29, 1974
Harvested: September 13, 1974

Variety	Description	Acre Yield		Sucrose	Root Rot	Beets/ 100'
		Sugar	Beets			
		Pounds	Tons	Percent	Percent	Number
317H8	F70-546H3 x 813	8,820	29.55	14.9	3.9	127
317TH8	F70-546H3 x 117T	8,440	28.68	14.7	10.0	120
317H52	8522H1 x 813	8,430	28.66	14.7	4.8	123
317TH52	8522H1 x 117T	8,010	27.67	14.5	13.5	120
317H62	8536H1 x 813	8,040	27.23	14.8	5.7	121
317TH62	8536H1 x 117T	7,780	26.83	14.5	11.0	122
Mean		8,250	28.10	14.7	8.2	122
LSD (.05)		404	1.23	0.26	3.69	NS
Coefficient of Variation (%)		5.4	4.8	2.0	50.2	6.3
F value		7.09**	5.72**	3.60**	9.05**	1.12

** Exceeds the 1% point of significance (F = 3.45).

TEST 874. HYBRID X VIRUS YELLOWS TEST, SALINAS, CALIFORNIA, 1974

7 replications
2 virus treatments
2-row plots, 37 ft. long

Planted: January 29, 1974
Inoculated: May 30, 1974
Harvested: September 16-18, 1974

Variety	Description	Sugar Yield (lb/A)			Beet Yield (Tons/A)			% Sucrose			Beets/ 100'	Root Rot
		Check	Inoc.	% Loss	Check	Inoc.	% Loss	Check	Inoc.	Loss	Number	%
323-1H8	F70-546H3 x 223-1	10,100	7,610	24.5	33.27	27.60	17.1	15.2	13.9	1.4	125	2.2
Y331H8	F70-546H3 x Y231	9,990	7,870	21.0	31.91	27.16	14.6	15.7	14.5	1.2	124	1.8
364H8	F70-546H3 x F66-64	9,820	7,070	27.9	31.65	25.18	20.3	15.6	14.1	1.5	123	1.2
Y301H8	F70-546H3 x Y201	9,810	8,160	16.9	30.89	28.04	11.0	15.9	14.6	1.3	122	1.5
Y204H8	F70-546H3 x Y104A,B	9,790	8,030	17.9	31.73	28.36	10.5	15.5	14.2	1.3	124	3.0
Y322H8	F69-546H3 x Y222A	9,570	7,470	21.4	32.37	26.17	18.5	14.8	14.3	0.6	128	1.6
Y333H8	F69-546H3 x Y233	9,510	7,570	19.9	32.10	27.36	14.8	14.9	13.9	1.0	125	1.9
317H52	8522H1 x 813	9,450	7,370	22.1	31.92	26.19	18.0	14.8	14.1	0.7	126	3.9
223-1H8	F70-546H3 x 123-1	9,430	7,260	22.6	31.70	26.22	17.0	14.9	13.9	1.0	126	2.3
323-3H8	F70-546H3 x 223-3	9,410	7,150	23.4	32.02	26.27	18.3	14.8	13.6	1.2	127	1.8
Y332H8	F70-546H3 x Y232	9,410	7,230	23.1	30.96	25.45	17.6	15.3	14.3	1.0	124	1.8
USH10B	546H3 x F71-17	9,390	7,500	19.9	31.37	26.63	15.1	15.1	14.2	0.9	128	2.2
USH9B	546H3 x F68-13	9,220	7,070	23.1	30.91	25.56	17.0	15.0	13.9	1.1	123	1.8
223-2H8	F70-546H3 x 123-2	9,220	7,590	17.7	31.08	26.84	13.5	14.9	14.2	0.8	127	1.7
223-3H8	F70-546H3 x 123-3	9,220	7,080	22.7	30.87	25.38	16.9	15.0	14.0	1.0	127	1.9
323-2H8	F70-546H3 x 223-2	9,160	7,740	15.2	30.37	27.63	10.0	15.1	14.0	1.1	126	1.6
Y329/1H8	F70-546H3 x Y229/1	8,980	7,680	15.3	29.23	26.65	10.4	15.4	14.4	1.0	129	1.4
317H62	8536H1 x 813	8,690	7,030	18.1	29.21	25.70	11.1	14.9	13.7	1.3	129	2.3
Mean		9,453[a]	7,470[b]	20.7	31.31[a]	26.58[b]	15.1	15.15[a]	14.08[b]	1.1	126	2.0
LSD (.05)		581	581	NS	2.08	2.08	NS	0.39	0.39	NS	4.4	1.3
Coefficient of Variation (%)		6.5	6.5	37.8	6.8	6.8	52.0	2.5	2.5	44.2	4.7	85.3
F value		4.1**	4.1**	NS	2.1**	2.1**	NS	7.7**	7.7**	NS	1.8*	1.9*

Significant variety x virus interactions did not occur for any variable.
Paired means with a letter in common are not significantly different.

* and ** Exceeds the 5% (F = 1.7) and 1% (F = 2.0) points of significance.

TEST 974. HYBRID X VIRUS YELLOWS TEST, SALINAS, CALIFORNIA, 1974

7 replications
2 virus treatments
1-row plots, 37 ft. long

Planted: January 30, 1974
Inoculated: May 30, 1974
Harvested: September 18-20, 1974

Variety	Description	Sugar Yield (lb/A)			Beet Yield (Tons/A)			% Sucrose			Beets/ 100'	Root Rot
		Check	Inoc.	% Loss	Check	Inoc.	% Loss	Check	Inoc.	Loss	Number	%
Y331H80	(564H0 x 1718) x Y231	10,300	7,040	31.4	33.38	24.99	24.6	15.5	14.1	1.4	125	1.6
Y301H82	(705H0 x 1718) x Y201	9,940	7,900	20.0	32.46	27.90	13.6	15.4	14.2	1.2	125	1.6
Y301H80	(564H0 x 1718) x Y201	9,900	7,360	25.4	32.72	25.40	22.1	15.2	14.5	0.9	128	1.9
Y335H8	F69-546H3 x F_2(813 x FC702/2)	9,870	6,820	31.1	32.78	24.42	25.3	15.2	14.0	1.2	128	1.3
Y322H80	(564H0 x 1718) x Y222A	9,550	6,980	26.1	32.81	25.75	20.5	14.7	13.6	1.0	127	1.6
Y322H82	(705H0 x 1718) x Y222A	9,540	6,970	26.4	32.02	24.96	21.3	15.0	14.0	1.0	125	1.6
Y331H82	(705H0 x 1718) x Y231	9,530	7,020	25.2	31.20	24.96	18.1	15.4	14.1	1.3	128	1.9
Y338H8	(F69-546H3) x F_2(813 x SP6822)	9,510	6,670	30.1	31.04	24.20	22.3	15.4	13.8	1.6	128	0.9
Y329/1H80	(564H0 x 1718) x Y229/1	9,490	7,200	23.3	31.01	25.84	16.5	15.3	14.0	1.3	130	1.1
Y332H80	(564H0 x 1718) x Y232	9,360	7,350	21.3	32.15	26.13	18.8	14.6	14.1	0.5	127	1.2
364H80	(564H0 x 1718) x F66-64	9,250	6,260	32.1	29.96	22.80	23.6	15.5	13.8	1.7	128	0.7
Y333H80	(564H0 x 1718) x Y233	9,230	6,830	26.0	31.23	25.24	19.2	14.9	13.6	1.3	125	2.6
364H82	(705H0 x 1718) x F66-64	9,190	6,430	30.3	29.68	23.63	21.0	15.6	13.8	1.8	130	0.9
Y332H82	(705H0 x 1718) x Y232	9,050	7,740	15.6	30.15	27.65	11.2	15.1	14.1	1.0	129	1.8
Y204H82	(705H0 x 9718) x Y104A,B	9,040	7,690	14.8	29.64	27.59	9.0	15.3	14.0	1.3	126	2.9
317H8	F70-546H3 x 813	9,030	6,850	23.5	29.64	24.54	16.5	15.3	14.0	1.3	130	1.5
317H81	(522H1 x 9718) x 813	9,010	7,260	20.2	30.47	26.32	14.9	15.0	13.8	1.2	129	1.8
317H80	(564H0 x 1718) x 813	8,900	7,070	20.2	29.80	25.49	14.0	15.0	13.9	1.1	131	0.5
317H82	(705H0 x 1718) x 813	8,900	7,040	20.7	29.64	25.15	15.1	15.1	14.1	1.0	128	2.5
Y334H8	F69-546H3 x F_2(813 x FC701/2)	8,860	6,620	24.4	28.66	23.40	18.1	15.5	14.2	1.3	127	0.1
3773H8	F70-546H3 x 1773-HGS	8,790	6,500	25.6	28.85	23.25	18.6	15.3	14.0	1.3	131	0.7
US H10B	546H3 x F71-17 (Lot 3084)	8,770	7,190	17.7	28.98	25.81	13.0	15.2	14.0	1.2	134	0.6
Y328H8	F70-546H3 x Y128	8,610	7,070	17.0	28.06	24.89	11.1	15.5	14.3	1.2	131	2.9
3791H8	F70-546H3 x 2791	8,550	5,780	32.1	28.47	21.00	25.5	15.1	13.8	1.3	129	1.5
Mean		9,257[a]	6,985[b]	24.2	30.62[a]	25.05[b]	18.1	15.21[a]	13.99[b]	1.2	128	1.5
LSD (.05)		750	750	9.2	2.62	2.62	9.2	0.40	0.40	0.5	NS	1.44
Coefficient of Variation (%)		8.8	8.8	35.8	8.9	8.9	48.2	2.6	2.6	40.9	5.9	130.7
F value		3.9**	3.9**	2.6**	3.8**	3.8**	2.0**	3.5**	3.5**	2.0**	NS	2.0**

Significant variety x virus interactions occurred for sugar yield, beet yield, and % sucrose at the .01, .05, and .01 levels, respectively.
Paired means with a letter in common are not significantly different.
**Exceeds the 1% (F = 1.8) point of significance.

TEST 1074. VARIETY X VIRUS YELLOWS TEST, SALINAS, CALIFORNIA, 1974

7 replications
2 virus treatments
1-row plots, 37 ft. long

Planted: January 30, 1974
Inoculated: May 24, 1974
Harvested: September 23-25, 1974

		Sugar Yield (lb/A)			Beet Yield (tons/A)			% Sucrose			Beets/ 100'	Root Rot
Variety	Description	Check	Inoc.	% Loss	Check	Inoc.	% Loss	Check	Inoc.	Loss	Number	%
Y301	Inc. Y201	10,770	8,120	24.1	36.17	28.88	19.7	14.9	14.1	0.8	122	1.2
Y319	Inc. Y119 (T-0 Y03)	10,770	7,610	28.7	35.03	27.21	21.5	15.4	14.0	1.4	128	0.9
Y331	Inc. Y231 (BRS Y01)	10,630	7,880	25.7	34.55	28.16	18.8	15.4	14.1	1.3	125	2.9
Y303	Inc. Y603	10,580	7,770	26.2	34.43	28.16	18.6	15.4	13.8	1.5	129	1.7
Y320	Inc. Y120 (T-0 10)	10,460	7,390	29.2	37.43	28.88	22.3	14.1	12.8	1.3	130	0.8
Y318	Inc. Y118 (T-0 Y04)	10,320	7,920	23.0	37.40	31.01	17.0	13.8	12.8	1.0	133	1.4
364	Inc. F66-64	10,250	6,130	40.5	34.30	23.82	30.9	15.0	12.9	2.1	126	1.4
USH10B	546H3 x F71-17 (3084)	10,140	7,590	25.1	34.11	27.30	20.1	14.9	13.9	1.0	134	2.1
Y204	Inc. Y104A,B	9,380	7,280	21.6	33.10	26.95	17.5	14.2	13.5	0.7	126	2.6
223-1	Inc. 123-1	9,330	6,430	30.4	33.60	24.86	24.8	13.9	13.0	1.0	129	3.4
868	Inc. F57-68 (US 75)	9,220	5,330	42.0	32.21	21.28	33.8	14.3	12.6	1.8	130	1.6
Y333	Inc. Y233 (BRS 13)	9,160	6,740	26.6	32.81	26.29	19.8	14.0	12.8	1.3	130	3.3
223-2	Inc. 123-2	9,040	6,370	29.1	31.77	23.59	25.4	14.2	13.5	0.7	131	2.6
323-2	Inc. 123-2,223-2	8,900	6,350	28.5	31.80	24.42	23.0	14.0	13.0	1.0	128	3.0
Y322	Inc. Y222A	8,840	6,940	21.1	30.40	26.22	13.4	14.6	13.3	1.3	136	2.6
323-1	Inc. 123-1,223-1	8,740	6,700	22.8	31.67	25.34	19.2	13.8	13.2	0.6	127	4.8
F70-13	Inc. F66-13	8,680	5,910	31.4	30.53	22.74	25.0	14.3	13.0	1.2	124	2.4
223-3	Inc. 123-3	8,540	5,680	33.6	30.34	22.30	26.9	14.1	12.8	1.3	123	3.1
F71-17	Inc. F70-17	8,520	7,020	17.9	29.14	25.53	12.6	14.7	13.8	0.9	129	3.1
317	Inc. 813 (C17)	8,510	6,740	20.9	29.11	24.20	17.0	14.7	14.0	0.8	127	4.1
Y332	Inc. Y232 (BRS Y22)	8,440	6,870	18.4	29.14	24.48	15.5	14.6	14.0	0.6	129	1.8
813	Inc. 713A	8,410	6,760	19.7	29.77	24.23	18.7	14.2	14.0	0.4	128	5.3
Y328	Inc. Y128	8,240	6,530	20.3	27.40	23.25	14.8	15.1	14.1	1.0	130	2.4
323-3	Inc. 123-3,223-3	8,190	5,760	29.4	29.55	22.55	23.8	13.9	12.8	1.1	126	1.9
Y317	Inc. Y117 (T-0 13)	8,180	6,380	21.3	28.28	23.72	15.9	14.5	13.5	1.0	134	6.0
Y329/1	Inc. Y229/1	8,030	6,270	21.4	27.36	21.76	20.1	14.7	14.4	0.3	128	2.7
Mean		9,242[a]	6,787[b]	26.1	31.98[a]	25.27[b]	20.6	14.49[a]	13.45[b]	1.1	128	2.7
LSD (.05)		652	652	8.5	2.37	2.37	8.9	0.47	0.47	0.7	6.9	1.8
Coefficient of Variation (%)		7.7	7.7	30.8	7.9	7.9	40.8	3.2	3.2	58.9	7.2	91.6
F value		21.5**	21.5**	4.1**	17.8**	17.8**	2.6**	16.2**	16.2**	3.0**	1.9**	4.0**

Significant variety x virus interactions occurred for sugar yield, beet yield, % sucrose, and root rot at the 1% level.
Paired means with a letter in common are not significantly different.
** Exceeds the 1% (F = 1.8) level of significance.

TEST 1174. YELLOWS AND COMBINING ABILITY EVALUATION OF 773 POPULATIONS, SALINAS, CALIFORNIA, 1974

7 replications
2 virus treatments
1-row plots

Planted: January 30, 1974
Inoculated: May 24, 1974
Harvested: September 25-26, 1974

Variety	Description	Sugar Yield (lbs/A)			Beet Yield (tons/A)			% Sucrose			Beets/ 100'	Root Rot
		Check	Inoc.	% Loss	Check	Inoc.	% Loss	Check	Inoc.	Loss	Number	%
3773H8	546H3 x 1773-HGS Sel.	10,620	7,440	29.8	35.19	27.74	21.1	15.1	13.5	1.7	133	0.7
3773CH8	546H3 x 1773-LGS Sel.	10,310	7,410	28.3	35.60	27.55	22.7	14.6	13.5	1.1	132	0.6
3773DH8	546H3 x 1773-HS Sel.	10,290	7,940	22.8	33.89	28.25	16.7	15.3	14.1	1.2	133	0.4
USH10B	546H3 x F71-17(3084)	10,270	7,880	22.5	34.68	29.04	16.2	14.8	13.6	1.2	135	2.7
3773BH8	546H3 x 2773B(Mass Sel.)	10,200	7,510	26.1	34.74	27.46	20.7	14.7	13.7	1.0	131	0.3
3773EH8	546H3 x 1773-LS Sel.	10,180	6,900	31.7	35.31	26.00	26.0	14.5	13.3	1.2	125	0.8
2773H8	546H3 x 1773	10,030	7,330	26.3	34.01	27.30	19.3	14.8	13.5	1.3	134	1.0
Mean		10,271[a]	7,489[b]	26.8	34.77[a]	27.62[b]	20.4	14.82[a]	13.59[b]	1.2	132	0.9
LSD (.05)		NS	NS	NS	NS	NS	NS	0.46	0.46	NS	NS	0.9
Coefficient of Variation (%)		8.4	8.4	33.5	7.1	7.1	37.7	3.0	3.0	53.5	6.5	130.3
F value		NS	NS	NS	NS	NS	NS	4.9**	4.9**	NS	NS	6.0**
3773	Inc. 1773-HGS Sel.	10,660	8,260	22.1	36.42	30.15	16.9	14.7	13.7	0.9	125	1.2
2773	Inc. 1773	10,370	7,430	28.0	35.82	28.09	21.1	14.5	13.3	1.2	119	0.4
3773B	Inc. 2773B (Mass Sel.)	10,220	7,810	23.5	34.87	28.76	17.6	14.7	13.6	1.1	120	1.2
3773D	Inc. 1773-HS Sel.	9,280	6,990	24.0	30.75	25.34	17.0	15.1	13.8	1.3	124	1.3
3773C	Inc. 1773-LGS Sel.	9,100	6,480	28.6	33.03	25.65	21.7	13.8	12.6	1.2	125	1.8
317	Inc. 813 (C17)	8,770	7,130	18.4	30.53	26.41	13.1	14.4	13.6	0.9	128	5.3
3773E	Inc. 1773-LS Sel.	8,760	6,480	25.2	32.40	26.00	19.2	13.6	12.4	1.2	124	2.8
Mean		9,595[a]	7,226[b]	24.3	33.40[a]	27.20[b]	18.1	14.40[a]	13.29[b]	1.1	123	2.0
LSD (.05)		635	635	NS	2.58	2.58	NS	0.4	0.4	NS	NS	1.8
Coefficient of Variation (%)		7.1	7.1	32.8	8.0	8.0	52.0	2.8	2.8	54.4	10.0	120.8
F value		19.6**	19.6**	NS	9.8**	9.8**	NS	26.6**	26.6**	NS	NS	6.3**

Significant variety x virus interactions did not occur.

Paired means with a letter in common are not significantly different.

** Exceeds the 1% (F = 3.1) point of significance.

TEST 1274. YELLOWS EVALUATION OF COMPANY HYBRIDS, SALINAS, CALIFORNIA, 1974.

7 replications
2 virus treatments
1-row plots, 37 ft. long

Planted: February 6, 1974
Inoculated: May 24, 1974
Harvested: September 30, 1974

		Sugar Yield (lbs/A)			Beet Yield (tons/A)			% Sucrose					
Variety	Description	Check	Inoc.	% Loss	Check	Inoc.	% Loss	Check	Inoc.	Loss	Beets/ 100' Number	Bolting %	Root Rot %
ACS-3	S-72-400	12,660	7,220	42.4	39.43	25.59	34.4	16.1	14.1	2.0	136	0.8	4.7
ACS-1	S-72-320	12,300	8,090	34.4	37.47	27.02	28.2	16.4	15.0	1.4	135	1.7	0.9
U & I-2	F_1CMS x 514469	11,460	6,310	44.1	38.83	25.87	32.5	14.8	12.3	2.5	131	3.9	2.5
Y204H82	1718H54 x Y104A,B	11,370	7,880	30.5	37.66	29.07	22.8	15.1	13.6	1.5	130	0.3	4.4
U & I-3	F_1CMS x 515069	11,260	6,110	44.6	36.64	22.93	36.0	15.4	13.3	2.1	82	1.0	1.9
GW-2	72MSH1047	11,160	7,640	31.4	37.72	28.50	24.3	14.8	13.4	1.4	117	0.0	3.0
GW-3	72MSH1053	11,160	7,810	29.5	37.94	29.71	22.4	14.7	13.1	1.6	122	0.3	4.2
Sprec.-3	H72186	11,010	7,490	31.7	36.64	27.78	23.6	15.1	13.5	1.6	137	0.0	1.2
Sprec.-1	H71189	10,860	7,200	33.2	36.33	26.41	26.6	15.0	13.6	1.4	137	0.0	0.2
U & I-1	F_1CMS x C713	10,750	6,930	35.4	36.71	25.94	29.2	14.7	13.4	1.3	125	0.3	2.6
364H8	F70-546H3 x F66-64	10,750	6,730	37.3	35.47	25.05	29.4	15.2	13.5	1.7	132	0.0	0.5
Y301H82	2718H54 x Y201	10,720	7,990	25.4	36.23	29.26	19.1	14.8	13.7	1.2	131	0.3	3.0
GW-1	Mono-Hy D2-73	10,710	7,040	34.0	34.24	26.13	23.4	15.7	13.5	2.2	133	0.2	2.6
Holly-3	2312-0108	10,560	6,530	37.7	35.63	25.40	28.2	14.9	12.9	2.0	132	7.1	1.4
Sprec.-2	S101H14(L2232)	10,540	7,160	31.8	35.22	26.44	24.2	15.0	13.6	1.5	140	0.0	2.4
USH10B	546H3 x F71-17(3084)	10,410	7,670	26.4	35.25	28.12	20.4	14.8	13.7	1.1	132	0.0	2.0
ACS-2	S-73-1196	10,350	7,060	31.7	33.19	25.46	23.3	15.6	13.9	1.7	125	3.7	4.6
Holly-2	9330-02	10,150	6,170	39.2	33.16	23.69	28.7	15.3	13.1	2.3	134	10.5	0.5
Amal.-3	Lot 2138	10,070	6,190	38.2	33.25	22.71	31.4	15.2	13.7	1.5	140	0.9	3.2
Holly-1	33115-02	9,980	7,060	29.1	33.54	26.51	20.7	14.9	13.3	1.6	136	0.0	2.3
317H82	2718H54 x 813	9,980	7,410	25.3	33.54	27.40	17.8	14.9	13.5	1.4	131	0.0	4.9
Amal.-2	E116	9,880	5,570	42.7	31.70	20.62	33.8	15.6	13.5	2.1	138	3.6	1.6
HH 22	Commercial Hybrid	9,800	7,120	27.1	32.97	26.57	19.7	14.9	13.4	1.5	133	0.0	3.1
Amal.-1	Lot 2107	9,730	6,970	28.1	33.13	25.65	22.3	14.7	13.7	1.1	135	1.8	2.2
Mean		10,735[a]	7,056[b]	33.8	35.49[a]	26.16[b]	25.9	15.15[a]	13.50[b]	1.65	130	1.5	2.5
LSD (.05)		798	798	9.0	2.69	2.69	9.4	0.44	0.44	0.6	9.3	1.3	1.9
Coefficient of Variation (%)		8.5	8.5	25.2	8.3	8.3	34.5	2.9	2.9	36.5	9.6	111.5	102.1
F value		8.1**	8.1**	3.4**	7.3**	7.3**	2.4**	14.2**	14.2**	2.9**	12.2**	32.9**	4.0**

Significant variety x virus interactions occurred for sugar yield, beet yield, % sucrose, and % bolting at the 1% level.

Paired means with a letter in common are not significantly different.

** Exceeds the 1% (F = 1.8) point of significance.

TEST 1374. LOSSES DUE TO YELLOWS PER INTERVAL OF INFECTION, SALINAS, CALIFORNIA, 1974

8 replications
5 dates of inoculation
2-row plots, 25 ft. long

Planted: January 31, 1974
Harvested: October 26-27, 1974

Variety	Sugar Yield (lb/A) Check	8/13[1/]	7/3	5/30	4/25	Mean[2/]	Sugar Yield Loss (%) 8/13	7/3	5/30	4/25	Root Rot (%)	Beets/ 100'
364H8	10,365	10,737	9,469	7,156	4,802	8,506a	0.0	8.6	31.0	53.7	1.4	138
364	9,939	9,764	8,358	6,683	4,170	7,783b	1.8	15.9	32.8	58.0	2.0	128
US H10B	9,763	10,429	9,348	7,584	6,117	8,648a	0.0	4.3	22.3	36.8	3.1	140
813 (C17)	8,486	7,885	7,887	6,747	5,441	7,289c	7.1	7.1	20.5	35.9	5.7	131
Mean	9,638a	9,704a	8,766b	7,042c	5,132d	8,056	0.0	9.0	26.9	46.8	3.1	134

	Beet Yield (Tons/A) Check	8/13	7/3	5/30	4/25	Mean	% Sucrose Check	8/13	7/3	5/30	4/25	Mean
364H8	34.26	36.01	33.45	27.04	19.06	29.96a	15.2	14.9	14.2	13.2	12.6	14.01a
364	34.28	33.29	30.42	25.79	16.96	28.15b	14.5	14.6	13.8	13.0	12.3	13.64b
US H10B	33.93	35.71	32.96	27.55	23.16	30.66a	14.4	14.6	14.2	13.8	13.2	14.03a
813 (C17)	29.06	27.18	27.81	24.23	20.03	25.66c	14.6	14.5	14.2	13.9	13.6	14.17a
Mean	32.88a	33.05a	31.16b	26.15c	19.80d	28.61	14.67a	14.67a	14.08b	13.46c	12.92d	13.96

1/ Dates of inoculation with BYV-BWYV.

2/ Variety means or inoculation date means with a letter in common are not significantly different at the 5% level according to Duncan's multiple range test.

Significant (P = .01) variety x inoculation date interactions occurred for sugar yield, beet yield, and % sucrose.

LSD (.05) for differences between varieties for the same inoculation date are 593 lbs/A, 2.13 T/A, and 0.35% for sugar yield, beet yield, and % sucrose, respectively.

LSD (.05) for differences within varieties for different inoculation dates are 649 lbs/A, 2.27 T/A, and 0.37% for sugar yield, beet yield, and % sucrose, respectively.

TEST 1774. YELLOWS EVALUATION OF MISC. BREEDING LINES, SALINAS, CALIFORNIA, 1974

7 replications
2 virus treatments
1-row plots, 37 ft. long

Planted: April 16, 1974
Inoculated: June 27, 1974
Harvested: October 7-9, 1974

Variety	Description	Sugar Yield (lb/A) Check	Inoc.	% Loss	Beet Yield (Tons/A) Check	Inoc.	% Loss	% Sucrose Check	Inoc.	Loss	Powdery Mildew Scores 1/	Root Rot No./Plot
BM	Bush Mono B4M/VT-70	9,410	5,660	39.8	28.16	19.76	29.8	16.7	14.3	2.4	5.2	0.4
3205	Inc. Acc. 127 (Cleij)	8,560	4,820	43.6	28.88	17.96	37.9	14.8	13.4	1.4	4.6	0.4
Maris	M. Vanguard(1967,7540)	8,460	4,560	45.7	28.92	17.77	38.2	14.6	12.8	1.8	4.6	0.2
Y338	F_3(SP6822-0(B) x 813)	7,900	4,150	47.2	25.11	14.54	42.0	15.7	14.3	1.5	6.0	0.1
Y339	Composite	7,790	5,110	34.2	24.67	17.80	27.6	15.8	14.3	1.5	6.4	0.2
RR 84	Erwinia R.S. F70-413	7,480	5,170	30.2	23.59	17.83	23.9	15.9	14.5	1.3	6.9	0.0
Y336	F_3(FC701/2,2/2 x Y002)	7,450	4,500	39.4	23.59	15.71	33.1	15.8	14.3	1.5	6.0	0.6
SP6822-0	From Coe (0147)	7,440	3,340	54.9	23.75	12.42	47.4	15.7	13.4	2.2	4.7	0.4
Y334	F_3(FC701/2 x 713A)	7,310	4,380	39.6	23.63	15.49	33.8	15.5	14.2	1.3	5.9	0.3
Y335	F_3(FC702/2 x 713A)	7,260	3,860	46.6	22.99	13.97	39.0	15.8	13.8	2.0	6.0	0.5
3204	Inc. Acc. 125 (Cleij)	7,160	4,750	33.1	22.52	16.22	27.3	15.9	14.6	1.3	4.0	0.1
US H10B	546H3 x F71-17 (3084)	7,130	5,520	21.8	23.34	19.22	17.3	15.3	14.4	1.1	7.2	0.1
868	Inc. F57-68 (US 75)	7,120	3,680	47.9	22.58	13.49	39.9	15.8	13.6	2.1	7.1	0.0
F70-413	Inc. F66-413	6,740	4,390	34.4	22.71	15.65	30.4	14.9	14.0	0.9	7.6	0.6
3791(Sp.)	2791aa x A	6,680	4,350	34.7	21.31	15.39	27.6	15.7	14.1	1.6	7.6	0.0
3207	Inc. Acc. 129 (Cleij)	6,590	4,410	32.3	22.45	16.53	25.8	14.7	13.4	1.3	6.0	0.3
R6	Fife's 614-R6-C(US 75)	6,400	3,700	41.9	20.08	12.99	34.9	15.9	14.2	1.7	8.1	0.6
RR 8	Erwinia R.S. F70-413	6,350	4,880	22.4	21.82	17.77	18.1	14.6	13.7	0.8	8.5	0.3
Y208	Inc. Y108 (13mm)	6,330	4,100	33.8	20.68	14.76	27.6	15.3	13.9	1.4	7.3	0.2
3206	Inc. Acc. 128 (Cleij)	6,140	4,310	29.5	20.52	15.90	22.2	15.0	13.6	1.4	7.1	0.6
3789	2775, 6aa x A	6,130	4,400	28.0	19.22	15.14	21.0	15.9	14.6	1.4	7.3	0.0
RS 3	Fife's 93-RS3-C(US 75)	6,090	3,970	34.9	19.10	14.32	25.0	16.0	13.9	2.1	8.5	0.1
3790	2792,3,4,5,7,8aa x A	5,820	3,980	31.1	18.75	14.19	23.7	15.5	14.0	1.5	7.6	0.0
3201	F_2B_2(RY x 868)	5,750	3,100	46.0	20.02	12.35	38.1	14.4	12.5	1.8	6.4	0.0
Mean		7,062	4,378	37.2	22.85	15.71	30.5	15.46	13.91	1.5	6.5	0.25
LSD (.05)		535	535	9.5	1.67	1.67	9.3	0.42	0.42	0.6	0.51	0.40
Coefficient of Variation (%)		8.9	8.9	24.0	8.2	8.2	28.9	2.7	2.7	35.1	10.5	216.2
F value		25.1**	25.1**	6.1**	26.6**	26.6**	5.7**	23.4**	23.4**	3.9**	47.7**	2.3**

Significant variety x virus interactions occurred for sugar yield, beet yield, % sucrose, and powdery mildew scores at P = .01. LSD (.05) for differences within varieties for different virus treatments equals 530 lbs/A, 1.9 T/A, and 0.5% for sugar yield, beet yield, and % sucrose, respectively.

1/ Scores for powdery mildew were made on August 14, 1974, where 0 = no infection to 9 = 100% severity. Simple correlations between powdery mildew scores and sugar yield, beet yield, and % sucrose were r = -0.40, -0.43, -0.16, respectively.

TEST 1874. EVALUATION OF BEET MOSAIC VIRUS RESISTANT-SUSCEPTIBLE NEAR-ISOGENICS, SALINAS, CA, 1974

10 replications
4 virus treatments
1-row plots, 25 ft. long

Planted: May 10, 1974
Inoculated: June 28, 1974
Harvested: October 30-31, 1974

Isogenic Lines[1]	Sugar Yield (lb/A)					Sugar Yield Loss (%)			Beet Yield (Tons/A)				
	Check	BMV	BYV	BWYV	Mean	BMV	BYV	BWYV	Check	BMV	BYV	BWYV	Mean
F_3B_3 C01 BmBm[2]	7334	7300	5525	5883	6510	0.5	24.7	19.8	23.66	24.11	18.44	20.28	21.62
F_3B_3 C01 bmbm	7700	6824	5589	6264	6594	11.4	27.4	18.6	24.68	22.19	18.53	21.10	21.63
F_3B_3 C04 BmBm	5613	5364	4082	4919	4994	4.4	27.3	12.4	19.21	18.60	14.72	17.59	17.53
F_3B_3 C04 bmbm	5985	5151	4926	5401	5366	13.9	17.7	9.8	19.81	17.59	16.86	18.46	18.18
F_3B_3 C17 BmBm	5872	5730	4116	5223	5235	2.4	29.9	11.1	19.76	19.47	14.49	18.16	17.97
F_3B_3 C17 bmbm	5830	5180	4912	5509	5358	11.1	15.7	5.5	19.16	17.40	16.69	18.79	18.00
813 (C17)	5537	4624	4334	5196	4923	16.5	21.7	6.2	18.35	15.87	14.80	17.66	16.67
Vytomo (Hilleshog)	7489	6002	5360	5987	6210	19.9	28.4	20.1	21.80	18.61	16.53	18.53	18.87
F_3B_3 C10 BmBm	6575	6852	5301	5173	5975	0.0	19.4	21.3	20.97	22.07	17.44	17.36	19.46
F_3B_3 C10 bmbm	6732	6195	5711	5804	6111	8.0	15.2	13.8	21.05	19.93	18.02	18.72	19.43
F_3B_3 C21 BmBm	6020	5711	4191	4762	5171	5.1	30.4	20.9	19.65	18.59	14.86	16.75	17.46
F_3B_3 C21 bmbm	5508	4546	4001	4201	4564	17.5	27.4	23.7	17.45	15.15	13.39	14.44	15.11
F_3B_3 C44 BmBm	6870	6893	5576	5792	6283	0.0	18.8	15.7	24.14	24.39	20.49	21.20	22.55
F_3B_3 C44 bmbm	6576	5833	5245	5942	5899	11.3	20.2	9.6	22.22	20.17	18.10	20.60	20.27
F_3B_3 9101 BmBm	5800	5536	3436	4523	4824	4.6	40.8	22.0	19.60	19.39	12.88	16.46	17.08
F_3B_3 9101 bmbm	5332	3859	2747	4089	4007	27.6	48.5	23.3	17.87	13.76	9.84	14.34	13.95
Mean[3]	6298a	5725b	4691d	5292c	5502	9.1	25.5	16.0	20.59a	19.21b	16.00d	18.15c	18.49
LSD (.05)	433	433	433	433	443	--	--	--	1.37	1.37	1.37	1.37	1.30
Isogenic Type													
BmBm Isogenics[4]	6294	6183	4592	5170	5560	2.4	27.3	17.6	20.99	20.90	16.20	18.22	19.08
bmbm Isogenics	6231	5345	4706	5306	5397	14.4	24.6	14.9	20.32	18.01	15.90	18.07	18.07
	NS[5]	**	NS	NS	NS	--	--	--	NS	**	NS	NS	**

Significant (P = 0.01) isogenic line x virus interactions occurred for sugar yield, beet yield, % sucrose, root rot, and powdery mildew. Significant (P = 0.01) isogenic type x virus interactions occurred for sugar yield, beet yield, and % sucrose.

1/ BmBm = beet mosaic virus resistant; bmbm = beet mosaic virus susceptible. Generation and recurrent parent.

2/ LSD (.05) for differences within isogenic lines for different virus treatments are 581 lbs/A, 1.76 T/A, and 0.48% for sugar yield, beet yield, and % sucrose, respectively.

TEST 1874. EVALUATION OF BEET MOSAIC VIRUS RESISTANT-SUSCEPTIBLE NEAR-ISOGENICS, SALINAS, CA, 1974 cont.

Isogenic Lines	% Sucrose					Sucrose Loss (% pts.)			Beets/ 100' Number	Root Rot %	Powdery Mildew Score 6/
	Check	BMV	BYV	BWYV	Mean	BMV	BYV	BWYV			
F_3B_3 C01 BmBm	15.52	15.14	14.98	14.52	15.04	0.38	0.54	1.00	123	2.7	5.1
F_3B_3 C01 bmbm	15.63	15.37	15.10	14.86	15.24	0.26	0.53	0.77	124	2.0	5.9
F_3B_3 C04 BmBm	14.65	14.46	13.90	14.06	14.27	0.19	0.75	0.59	124	3.3	8.2
F_3B_3 C04 bmbm	15.11	14.67	14.60	14.63	14.75	0.44	0.51	0.48	124	3.5	7.9
F_3B_3 C17 BmBm	14.85	14.71	14.23	14.39	14.55	0.14	0.62	0.46	125	5.5	6.7
F_3B_3 C17 bmbm	15.24	14.91	14.75	14.71	14.90	0.33	0.49	0.53	125	5.5	7.1
813 (C17)	15.10	14.63	14.68	14.71	14.78	0.47	0.42	0.39	113	8.5	7.0
Vytomo (Hilleshog)	17.18	16.13	16.14	16.17	16.41	1.05	1.04	1.01	145	3.7	5.8
F3B3 C10 BmBm	15.73	15.59	15.21	14.90	15.36	0.14	0.52	0.83	113	8.6	8.0
F_3B_3 C10 bmbm	15.99	15.55	15.88	15.52	15.74	0.44	0.11	0.47	113	8.3	6.5
F_3B_3 C21 BmBm	15.33	15.36	14.14	14.23	14.77	0.00	1.19	1.10	123	0.7	6.9
F_3B_3 C21 bmbm	15.80	15.02	14.92	14.58	15.08	0.78	0.88	1.22	122	1.1	7.2
F_3B_3 C44 BmBm	14.26	14.16	13.64	13.70	13.94	0.10	0.62	0.56	114	1.4	7.2
F_3B_3 C44 bmbm	14.81	14.47	14.48	14.43	14.55	0.34	0.33	0.38	121	0.2	7.1
F_3B_3 9101 BmBm	14.79	14.29	13.32	13.70	14.03	0.50	1.47	1.09	124	3.4	7.0
F_3B_3 9101 bmbm	14.91	14.02	13.97	14.22	14.28	0.89	0.94	0.69	129	2.3	7.6
Mean	15.31a	14.91b	14.62c	14.58c	14.85	0.40	0.69	0.73	123	3.8	6.9
LSD (.05)	0.34	0.34	0.34	0.34	0.38	--	--	--	7	2.2	0.5
Isogenic Type											
BmBm Isogenics	15.02	14.82	14.20	14.21	14.56	0.20	0.82	0.81	121	3.5	7.0
bmbm Isogenics	15.36	14.86	14.81	14.71	14.93	0.50	0.55	0.65	122	3.2	7.0
	**	NS	**	**	**	--	--	--	*	NS	--

3/ Virus treatment means with a letter in common are not significantly different at the 5% level.

4/ LSD (.05) for differences within isogenic types for different virus treatments are 172 lbs/A, 0.51 T/A, and 0.16% for sugar yield, beet yield, and % sucrose, respectively.

5/ **, *, and NS indicate level of significance between isogenic types for the same virus treatment.

6/ Scores for powdery mildew were made on August 28 where 0 = no infection to 9 = 100% severity.

Test 1574. Performance of Varieties from Netherlands & Poland, 1974

10 replications
1 row plots, 53 ft. long

Planted: February 26, 1974
Harvested: October 3, 1974

Variety No.	Description	Acre Yield Sugar Pounds	Acre Yield Beets Tons	Sucrose Percent	Root Rot Percent	Pow. Mildew Grade[1]	Vigor Grade[1]	Uniformity Grade[1]	Beets/ 100' Number
252/71	Polish triploid hybrid	12,560	37.29	16.87	1.4	4.3	3.7	5.2	106
P2	Polish triploid hybrid	12,010	34.13	17.61	1.9	4.7	3.8	4.5	121
USH10B	Local check	10,560	34.01	15.54	1.0	6.5	4.4	4.2	136
RW 660	Sel. from Netherlands	10,510	33.39	15.73	0.5	3.7	5.0	5.7	117
P1	Polish diploid hybrid	10,500	31.44	16.72	0.4	5.2	4.4	5.3	125
RW 268	Sel. from Netherlands	10,410	31.52	16.53	2.7	4.4	4.5	5.4	115
RW 968	Sel. from Netherlands	10,280	32.70	15.72	2.1	5.2	4.6	5.7	109
RW 880	Sel. from Netherlands	9,690	30.86	15.69	2.0	4.5	4.6	5.7	109
Mean		10,810	33.17	16.30	1.5	4.8	4.4	5.2	117
LSD (.05)		641	1.91	0.497	NS				6.81
Coefficient of Variation (%)		6.6	6.4	3.4	123.3				6.5
F value		17.89**	9.37**	17.95**	1.81				17.10**

** Exceeds the 1% point of significance (F = 2.93).

[1] Powdery mildew, vigor, and uniformity rated from 1 = most desirable rating to 10 = least desirable rating.

PERFORMANCE OF NEMATODE WILTING TOLERANT SELECTIONS, SALINAS, CALIFORNIA

10 replications of each variety
1 row plots, 20 feet long

Planted: May 18, 1974
Harvested: October 7, 1974

Under Nematode Free Conditions

Variety[1]	Acre Yield Sugar	Acre Yield Beets	Sucrose	Harvest Count	Wilting Grade[2] 8/5	Wilting Grade[2] 10/6
	Pounds	Tons	Percent	Number		
880	6,900	21.87	15.76	151	1.5	2.6
660	7,390	23.60	15.65	158	2.2	2.8
968	6,370	21.50	14.83	158	1.7	2.9
268	7,590	23.55	16.10	144	2.2	2.6
US H10B	6,390	21.15	15.10	167	3.0	2.8
Mean	6,930	22.33	15.49	Beets		
LSD (.05)	733	NS	0.36	per		
C.V. (%)	11.7	11.1	2.6	100'		
F value	4.83**	NS	16.85**	row		

Under Severe Nematode Infestation

					8/5	9/30
880	3,200	11.96	13.36	138	1.7	2.0
660	2,870	10.16	14.12	125	2.9	4.2
968	2,610	10.05	13.01	141	3.3	4.4
268	2,230	7.85	14.16	114	4.1	5.2
US H10B	1,180	4.53	13.00	130	5.4	6.6
Mean	2,420	8.91	13.53	Beets		
LSD (.05)	481	1.70	0.57	per		
C.V. (%)	21.9	21.0	4.6	100'		
F value	21.53**	23.14**	8.50**	row		

**Exceeds the 1% point of significance.

Loss in Sugarbeet Varietal Performance When Grown Under Severe Nematode Infestation in Contrast to Performance Under Nematode Free Conditions.

Variety	Acre Yield Sugar	Acre Yield Beets	Sucrose
	Percent	Percent	Percent
880	54	45	15
660	61	57	10
968	59	53	12
268	71	67	12
US H10B	82	79	14

1/ Varieties 880, 660, 968, and 268 selected by the Instituut voor Rationele Suikerproductie in the Netherlands for tolerance to wilting caused by the sugarbeet nematode. US H10B is an unselected check.

2/ 1 = No wilting, 10 = Severe wilting.

VARIETY TEST, IMPERIAL VALLEY, CALIFORNIA, 1974
by Holly Sugar Corporation

9 replications, 1 row plots
25 ft. long, 32 in. between rows

Planted: September 17, 1973
Harvested: June 3, 1974

Variety	Description	Ext. Sugar/A	Ext. Sugar/T	Gross Sugar/A	Beets/A	Sucrose	Beets/ 100'	Bolting
		Pounds	Pounds	Pounds	Tons	Percent	Number	Percent
Y322H80	(564HO x 718) x Y222A	9,324	257.1	11,857	36.4	16.31	148	5.7
Y301H80	(564HO x 718) x Y201	9,042	256.5	11,512	35.5	16.29	150	9.9
USH10A	569H3 x C17	8,975	265.7	11,230	33.8	16.62	141	11.0
317H80	(564HO x 718)xC17	8,770	257.4	11,143	34.2	16.33	153	2.3
Y204H8	546H3 x Y104	8,738	260.0	11,026	33.6	16.42	142	14.1
USH10B	546H3 x C17	8,722	265.4	10,934	33.0	16.61	146	6.4
317H52	522H1 x C17	8,580	262.7	10,815	32.9	16.50	152	1.7
317H81	(522H1 x 718) x C17	8,462	245.4	10,976	34.6	15.89	148	6.0
317H82	(705HO x 718) x C17	8,449	253.3	10,820	33.5	16.18	137	7.8
Y322H8	546H3 x Y222A	8,425	273.1	10,425	30.9	16.88	143	2.7
Y331H8	546H3 x Y231	8,140	262.1	10,252	31.1	16.49	139	4.9
Y301H8	546H3 x Y201	8,096	272.7	10,023	29.7	16.87	150	11.5
317H62	8536H1 x C17	7,879	250.2	10,143	31.7	16.07	147	2.1
Y329/1H8	546H3 x Y229/1	7,839	270.1	9,743	29.1	16.78	145	4.0
Test Mean		8,531	260.8	10,778	32.9	16.45	146	6.4
LSD (.05)		626	12.3	766	2.5	0.43	--	--
Coefficient of Variation (%)		8	5.0	8	8.2	2.82	--	--
Standard Error of the Mean		223	4.4	273	0.9	0.15	--	--
F value		3.86**	3.55**	4.76**	5.56**	3.60**	--	--

** Exceeds the 1% point of significance (F = 2.31).

VARIETY TEST, SOUTH SAN JOAQUIN VALLEY, CALIFORNIA, 1974
By Holly Sugar Corporation

9 replications, 1 row plots
25 ft. long, 30 in. between rows

Planted: February 11, 1974
Harvested: August 30, 1974

Variety	Description	Ext. Sugar/A	Ext. Sugar/T	Gross Sugar/A	Beets/A	Sucrose	Beets/ 100'
		Pounds	Pounds	Pounds	Tons	Percent	Number
Y301H80	(564H0 x 718) x Y201	7,175	219.1	9,221	33.1	14.03	150
364H80	(564H0 x 718) x F66-64	6,804	205.2	8,959	33.2	13.51	144
USH9B	546H3 x C13	6,554	201.0	8,700	32.6	13.34	147
317H80	(564H0 x 718) x C17	6,506	210.0	8,491	31.1	13.68	149
USH10B	546H3 x C817	6,468	211.2	8,423	30.7	13.74	151
317H81	(522H1 x 718) x C17	6,435	211.7	8,375	30.5	13.76	148
317H62	536H1 x C17	6,240	206.3	8,212	30.4	13.55	148
317H52	522H1 x C17	5,892	207.4	7,726	28.4	13.59	149
Test Mean		6,509	209.0	8,514	31.2	13.65	148
LSD (.05)		528	NS	625	2.6	NS	--
Coefficient of Variation (%)		9	8.0	8	8.9	4.84	--
Standard Error of the Mean		186	5.6	220	0.9	0.22	--
F value		4.10**	NS	4.34**	3.03**	NS	--

** Exceeds the 1% point of significance (F = 2.98).

VARIETY TEST, HAMILTON CITY, CALIFORNIA, 1974
By Holly Sugar Corporation

6 replications, 1 row plots
25 ft. long, 30 in. between rows

Planted: April 4, 1974
Harvested: September 15, 1974

Variety	Description	Ext. Sugar/A	Ext. Sugar/T	Gross Sugar/A	Beets/A	Sucrose	Beets/ 100'
		Pounds	Pounds	Pounds	Tons	Percent	Number
Y301H8	546H3 x Y201	5,329	178.9	7,409	29.8	12.44	141
Y301H80	(564HO x 718) x Y201	4,666	155.0	6,872	30.2	11.40	143
317H52	(705HO x 718) x C17	4,644	163.9	6,690	28.4	11.80	142
USH10B	546H3 x C17	4,561	163.9	6,557	27.8	11.78	148
Y334H8	546H3 x 234-1,2	4,504	155.4	6,598	29.0	11.38	151
USH10A	569H3 x C17	4,356	163.7	6,277	26.7	11.78	148
317H82	(705HO x 718) x C17	4,020	143.8	6,082	27.9	10.88	139
USH9B	546H3 x C13	3,998	142.3	6,075	28.2	10.79	144
317H80	(564HO x 718) x C17	3,990	146.3	6,011	27.4	11.01	140
Test Mean		4,452	157.0	6,508	28.4	11.47	144
LSD (.05)		583	19.0	646	NS	0.85	--
Coefficient of Variation (%)		11	10.3	9	7.3	6.38	--
Standard Error of the Mean		204	6.6	226	0.8	0.30	--
F value		4.46**	3.21**	4.06**	NS	3.20**	--

** Exceeds the 1% point of significance (F = 3.00).

Note: 5-10% rotten beets caused great variation in sucrose percentage.

VARIETY TEST, TRACY, CALIFORNIA, 1974
By Holly Sugar Corporation

9 replications, 1 row plots
25 ft. long, 30 in. between rows

Planted: May 21, 1974
Harvested: October 20, 1974

Variety	Description	Ext. Sugar/A	Ext. Sugar/T	Gross Sugar/A	Beets/A	Sucrose	Beets/ 100'
		Pounds	Pounds	Pounds	Tons	Percent	Number
Y329/1H8	546H3 x Y229/1	8,181	281.1	9,478	29.2	16.26	143
Y301H8	546H3 x Y201	8,067	280.9	9,339	28.7	16.26	137
317H52	522H1 x C17	8,005	276.9	9,349	29.1	16.12	142
Y301H80	(564H0 x 718) x Y201	7,966	286.3	9,172	28.0	16.43	136
Y331H8	546H3 x Y231	7,932	287.2	9,100	27.6	16.47	132
317H62	8536H1 x C17	7,921	277.5	9,219	28.6	16.14	142
317H80	(564H0 x 718) C17	7,779	276.3	9,068	28.2	16.10	132
Y322H8	546H3 x Y222A	7,663	287.7	8,814	26.9	16.48	139
Y204H8	546H3 x Y104	7,646	269.1	9,016	28.5	15.86	132
USH10A	569H3 x C17	7,603	286.8	8,742	26.7	16.45	134
364H80	(564H0 x 718) x F66-64	7,537	275.1	8,829	27.6	16.06	141
317H81	(522H1 x 718) x C17	7,451	269.5	8,793	27.8	15.87	137
USH9B	546H3 x C13	7,317	261.8	8,745	28.1	15.60	130
USH10B	546H3 x C17	7,304	278.3	8,512	26.5	16.16	141
317H82	(705H0 x 718) x C17	7,223	260.7	8,636	27.8	15.56	134
Test Mean		7,706	277.0	8,987	28.0	16.12	137
LSD (.05)		NS	NS	NS	NS	NS	--
Coefficient of Variation (%)		10	7.1	10	11.2	4.15	--
Standard Error of the Mean		248	6.6	292	1.0	0.22	--
F value		NS	NS	NS	NS	NS	--

Bolting Resistance Test
by Holly Sugar Corporation
Tracy, California

Planted: Oct. 6, 1973
Counted: May 21, 1974

Variety No.	Description	Percent Bolting
3718H0B	2718H0 x 2718	0
317H80	2718H5 x C17	0
317TH8	F70-546H3 x 117T	0
317TH52	8522H1 x 117T	0
3536-97H3	F66-562H0 x 8536-97	0
317TH62	8536H1 x 117T	0.9
3546H72B	2718H0 x F70-546	1.7
USH9A		1.7
3536-97H23	1522H52 x 8536-97	2.4
3718H3	F66-562H0 x 2718	2.5
317H8	F70-546H3 x C17	2.5
317H81	1718H52 x C17	2.7
317H52	8522H1 x C17	2.7
Y332H8	F70-546H3 x Y232	2.7
317	Inc. 813	3.0
3718H54	2705H0 x 2718	3.4
Y333H8	F69-546H3 x Y233	3.7
Y329/1H8	F70-546H3 x Y229/1	3.7
Y204H8	F70-546H3 x Y104	3.9
Y322H80	2718H5 x Y222A	4.7
317H62	8536H1 x C17	4.7
USH10B		5.9
323-1	Inc. 123-1 and 223-1	7.1
Y301H80	2718H5 x Y201	7.5
Y204H81	1718H52 x C17	8.0
Y227H8	F70-546H3 x Y127	8.1
323-3	Inc. 123-3 and 223-3	9.4
USH10A		9.7
Y331H8	F70-546H3 x Y231	10.3
317H82	2718H54 x C17	10.4
Y322H8	F69-546H3 x Y222A	10.4
F70-13	Inc. C413	10.5
Y332H80	2718H5 x Y232	10.7
USH9B		10.9
Y301H82	2718H54 x Y201	16.8
323-2	Inc. 123-2 and 223-2	17.2
Y301H8	F70-546H3 x Y201	17.9
Y334H8	F69-546H3 x Y234	24.2

DATA ON USDA VARIETIES TESTED BY SPRECKELS SUGAR - 1974

TEST AREAS:		SPRECKELS			MENDOTA		
Variety	Description	Sugar T/Ac.	Beets T/Ac.	% Sug.	Sugar T/A.	Beets T/Ac.	% Sug.
364H80	2718H5 x F66-64				3.114	18.04	17.3
317H52	8522H1 x C17	4.433	32.65	13.7	3.842	22.36	17.2
317H62	8536H1 x C17	3.992	28.61	14.0	3.090	17.97	17.2
317H80	2718H5 x C17	4.625	33.11	14.1	3.788	21.35	17.8
317H82	2718H54 x C17	4.587	33.70	13.7			
Y301H8	F70-546H3 x Y201	4.711	32.94	14.5	4.115	23.88	17.6
Y301H80	2718H5 x Y201				3.615	20.31	17.9
H322H8	546H3 x Y222A	4.361	31.05	14.2			
US H9B	546H3 x C413	4.257	32.76	13.2	4.061	23.08	17.7
US H10B	546H3 x C817				4.103	23.21	17.8
GENERAL MEAN		4.455	32.11	14.0	4.078	22.86	17.9
LSD @ P = .05		0.399	2.71	0.6	0.495	2.73	0.7
LSD @ P = .01		0.505	NS	0.8	0.625	3.45	0.9
S E of Mean		0.153	1.036	0.234	0.189	1.043	0.282
S E in % of Mean		3.43	3.23	1.68	4.64	4.56	1.58
No. of Varieties in Test			16			16	
Planting Date			December 19, 1973		March 6, 1974		
Harvest Date			August 28, 1974		September 27, 1974		

1974 BOLTING DATA OF USDA ENTRIES

SUBMITTED FOR THE SPRECKELS NB NURSERY AT SPRECKELS, CALIFORNIA

AVERAGE OF 2 REPLICATIONS

ENTRY	PERCENT BOLTING 7-1-74	8-7-74	9-17-74	Stand
US H9B	1	4	7	64
US H10B	2	6	8	58
364H80	0	5	6	54
317H52	3	6	13	55
317H62	3	10	13	65
317H80	0	5	5	46
317H82	0	3	8	56
Y301H8	2	5	10	50
Y301H80	2	4	9	47
Y322H8	2	6	8	60
Y331H8	2	5	7	50
Y332H8	1	4	6	52
Y333H8	1	3	4	47
Y334H8	5	9	13	43
Y335H8	7	15	17	40
323-1H8	4	8	13	45
323-2H8	5	11	17	53
323-3H8	2	9	13	56
3705H3	4	8	10	60
3718H3	1	6	8	48
3718H54	2	8	13	57
3546H54	1	5	7	62
3546H72B	3	6	10	50
3718H0B	1	6	8	51
C546H3	1	7	Omitted	65
Mono Hy D2	16	29	Omitted	60

Planting Date: December 12, 1973

1974 CURLY TOP DATA OF USDA ENTRIES

SUBMITTED FOR THE SPRECKELS CTR NURSERY, SAN JOAQUIN VALLEY, CALIF.

Average of 2 Replications

ENTRY	CT GRADE[1/] 7/2/74	7/23/74
S-1, Susc. Check	8.0	9.0
S-2, Res. Check	6.	7.
3536-97H3	6	5
3536-97H23	6	5
8522H1	7	8
C546H3	7	8
317H52	7	6
317H62	7	7
317H81	7	7
US H9B	7	7
US H10B	7	7
Mono Hy D2	8	8

1/ CT Grade based on 1 = very minor symptoms to 10 = dead or nearly so from Curly Top.

Nursery was planted April 29, 1974

Other Observations:

5/15/74 Obtained good emergence; 15% CT counted on adjacent commercial beets planted in January.

5/31/74 Good CT symptoms in nursery, but not 100%. Commercial beets showed 36% infection.

7/ 2/74 100% infection by this date. Susceptible check not as yellow or severely stunted as in previous years.

7/23/74 Some lines showed some recovery in foliage size or had an increased rate of growth so that their grades were lower than the previous reading.

VARIETY TEST, CLARKSBURG, CALIFORNIA, FALL HARVEST, 1974
By American Crystal Sugar Company
42402

6 replications, Equalized Random Block Design
2 row plots, 35 ft. long, 30 in. rows

Planted: May 9, 1974
Harvested: September 6, 1974

Variety	Description	Acre Yield Gross Sugar Pounds	Acre Yield Recov. Sugar Pounds	Beets Tons	Sucrose Percent	Recov. Sugar/ton Pounds	Amino N PPM	Na PPM	K PPM	Impurity Index
Y301H80	(564HO x 718) x Y201	5,940	4,950	26.98	10.98	183	335	962	2392	1131
Y322H8	546H3 x Y222A	5,280	4,360	24.34	10.85	179	320	1030	2445	1164
Y301H8	546H3 x Y201	5,260	4,360	23.98	10.97	182	336	1035	2328	1138
Y331H8	546H3 x Y231	5,200	4,240	23.97	10.84	177	330	1121	2569	1230
Y204H16	546H5 x Y104	5,180	4,280	23.58	11.05	183	338	1032	2415	1150
Y334H8	546H3 x 234-1,2	5,010	4,090	23.42	10.68	174	375	1038	2410	1223
317H52	522H1 x C17	4,910	4,040	22.17	11.08	182	446	899	2371	1180
317H80	(564HO x 718) x C17	4,860	3,970	22.84	10.67	174	400	956	2454	1229
USH10B	546H3 x C17	4,860	4,050	21.89	11.10	185	343	902	2403	1104
317H82	(705HO x 718) x C17	4,820	3,920	22.09	10.90	177	381	1048	2649	1262
364H80	(564HO x 718) x F66-64	4,450	3,630	20.90	10.65	174	379	1084	2308	1222
317H62	8536H1 x C17	4,350	3,580	20.51	10.69	176	376	982	2257	1168
Mean		5,010	4,120	23.06	10.87	179	363	1007	2417	1183
LSD (.05)		549	470	2.45	NS	NS	NS	84	130	NS
Coefficient of Variation (%)		9.46	9.83	9.18	4.75	5.56	21.50	7.19	4.62	7.37
F value		4.6**	4.8**	4.1**	NS	NS	NS	5.3**	5.6**	NS

** Exceeds the 1% point of significance (F = 2.62).

VARIETY TEST, EAST GRAND FORKS, MINNESOTA, FALL HARVEST, 1974
By American Crystal Sugar Company
48409

6 replications, Equalized Random Block Design
2 row plots, 35 ft. long, 22 in. rows

Planted: May 24, 1974
Harvested: September 18, 1974

Variety	Description	Acre Yield: Gross Sugar Pounds	Acre Yield: Recov. Sugar Pounds	Beets Tons	Sucrose Percent	Recov. Sugar/ton Pounds	Amino N PPM	Na PPM	K PPM	Impurity Index
S71-861	ACS Variety	4,560	4,060	15.66	14.57	259	403	687	1883	738
217H80	1718H5 x 813	4,560	3,940	17.11	13.39	232	466	678	2129	901
S71-844	ACS Variety	4,420	3,890	15.46	14.27	252	429	697	2006	792
USH10B	546H3 x C17	4,400	3,820	16.82	13.12	228	432	720	1998	877
ACS Check		4,330	3,800	15.80	13.74	241	440	770	1828	822
217H79M	1705H72M x 813	4,280	3,710	16.40	13.03	226	453	723	2013	896
S71-681	ACS Variety	4,280	3,773	15.47	13.94	246	428	699	1838	784
Y204H8	546H3 x Y104	4,260	3,720	16.13	13.17	230	411	735	1940	848
217H52	8522H1 x 813	4,180	3,610	16.12	13.01	225	496	724	1906	910
Y227H8	546H3 x Y127	4,100	3,560	15.75	13.04	226	451	732	1987	892
217H81	1718H52 x 813	4,020	3,500	15.44	13.11	228	441	683	1982	875
217H16	546H5 x 813	4,020	3,500	15.11	13.36	233	446	724	1959	870
Mean		4,290	3,740	15.94	13.48	236	441	714	1956	851
LSD (.05)		NS	NS	NS	0.79	16.95	49.7	NS	NS	89.1
Coefficient of Variation(%)		9.53	9.83	10.26	5.05	6.20	9.72	11.86	8.45	9.03
F value		NS	NS	NS	3.7**	3.6**	2.0*	NS	NS	3.0**

* Exceeds the 5% point of significance (F = 1.98).
** Exceeds the 1% point of significance (F = 2.62).

VARIETY TEST, EAST GRAND FORKS, MINNESOTA, FALL HARVEST, 1974
By American Crystal Sugar Company
48501

6 replications, Equalized Random Block Design — Planted: May 24, 1974
2 row plots, 35 ft. long, 22 in. rows — Harvested: September 18, 1974

Variety	Description	Acre Yield: Gross Sugar	Acre Yield: Recov. Sugar	Beets	Sucrose	Recov. Sugar/ton	Amino N	Na	K	Impurity Index
		Pounds	Pounds	Tons	Percent	Pounds	PPM	PPM	PPM	
Y204H16	546H5 x Y104	4,730	4,030	17.95	13.17	224	497	868	2203	990
317H52	522H1 x C17	4,670	3,960	17.72	13.17	224	559	766	2204	1007
Y301H8	546H3 x Y201	4,580	3,910	16.97	13.51	231	489	945	2176	977
317H62	8536H1 x C17	4,580	3,890	17.23	13.30	226	546	811	2189	997
364H80	(564H0 x 718) x F66-64	4,530	3,820	16.94	13.35	225	551	969	2253	1051
USH10B	546H3 x C17	4,490	3,840	16.86	13.31	228	488	807	2258	967
Y301H80	(564H0 x 718) x Y201	4,430	3,780	16.75	13.26	226	489	923	2166	987
Y334H8	546H3 x 234-1,2	4,420	3,720	16.86	13.12	221	567	927	2205	1058
317H80	(564H0 x 718) x C17	4,400	3,720	16.74	13.12	221	551	823	2329	1043
Y322H8	546H3 x Y222A	4,360	3,720	16.26	13.41	229	526	819	2217	982
Y331H8	546H3 x Y231	4,330	3,670	16.17	13.40	227	514	896	2346	1018
317H82	(705H0 x 718) x C17	4,280	3,640	16.20	13.21	224	486	791	2446	1005
Mean		4,480	3,810	16.89	13.28	226	522	862	2249	1007
LSD (.05)		NS	NS	NS	NS	NS	42.1	89.7	152.4	54.3
Coefficient of Variation (%)		6.98	7.08	6.61	2.36	2.97	6.95	8.97	5.84	4.65
F value		NS	NS	NS	NS	NS	4.7**	4.6**	2.5*	2.4*

* Exceeds the 5% point of significance (F = 1.98).
**Exceeds the 1% point of significance (F = 2.62).

VARIETY TEST, MOORHEAD, MINNESOTA, FALL HARVEST, 1974
By American Crystal Sugar Company
48410

6 replications, Equalized Random Block Design
2 row plots, 35 ft. long, 22 in. rows

Planted: June 3, 1974
Harvested: October 1, 1974

Variety	Description	Acre Yield: Gross Sugar Pounds	Acre Yield: Recov. Sugar Pounds	Beets Tons	Sucrose Percent	Recov. Sugar/ton Pounds	Amino N PPM	Na PPM	K PPM	Impurity Index
217H81	1718H52 x 813	5,830	4,940	19.92	14.65	248	645	640	2719	1016
USH10B	546H3 x C17	5,740	4,900	19.79	14.52	248	580	615	2752	984
217H80	1718H5 x 813	5,740	4,880	19.88	14.45	246	626	568	2717	1000
217H52	8522H1 x 813	5,650	4,850	19.43	14.56	249	680	563	2550	993
217H79M	1705H72M x 813	5,540	4,740	19.04	14.58	249	568	586	2745	964
S71-844	ACS Variety	5,470	4,790	16.87	16.23	284	582	575	2481	829
ACS Check		5,440	4,660	18.06	15.05	258	648	750	2362	954
S71-861	ACS Variety	5,400	4,780	16.04	16.85	298	551	634	2358	776
217H16	546H5 x 813	5,400	4,620	18.10	14.94	256	613	640	2648	964
Y204H8	546H3 x Y104	5,380	4,570	18.56	14.47	246	619	654	2674	1006
Y227H8	546H3 x Y127	5,330	4,520	18.57	14.46	244	622	629	2719	1011
S71-681	ACS Variety	5,080	4,380	17.24	14.72	254	586	678	2372	923
Mean		5,500	4,720	18.46	14.96	257	610	628	2591	952
LSD (.05)		380	333	1.19	0.58	12.2	71	83	188	77
Coefficient of Variation(%)		5.95	6.08	5.58	3.37	4.11	10.02	11.36	6.24	6.94
F value		2.5*	2.2*	8.9**	14.2**	15.4**	2.3*	3.3**	5.8**	7.8**

* Exceeds the 5% point of significance (F = 1.98).
** Exceeds the 1% point of significance (F = 2.62).

VARIETY TEST, DRAYTON, NORTH DAKOTA, FALL HARVEST, 1974
By American Crystal Sugar Company
48412

6 replications, Equalized Random Block Design
2 row plots, 35 ft. long, 22 in. rows

Planted: June 4, 1974
Harvested: October 6, 1974

Variety	Description	Acre Yield								
		Gross Sugar	Recov. Sugar	Beets	Sucrose	Recov. Sugar/ton	Amino N	Na	K	Impurity Index
		Pounds	Pounds	Tons	Percent	Pounds	PPM	PPM	PPM	
217H81	1718H52 x 813	4,940	4,190	18.33	13.51	230	454	461	3147	1008
ACS Check		4,530	3,950	15.69	14.44	252	438	508	2612	850
217H80	1718H5 x 813	4,510	3,850	16.50	13.70	234	453	473	3073	988
217H16	546H5 x 813	4,460	3,810	16.28	13.73	234	457	500	3014	980
217H52	8522H1 x 813	4,410	3,800	16.16	13.68	235	432	461	2883	935
217H79M	1705H72M x 813	4,350	3,670	15.70	13.84	234	498	512	3238	1042
USH10B	546H3 x C17	4,340	3,690	16.15	13.48	230	456	476	3017	991
S71-844	ACS variety	4,280	3,750	14.44	14.81	259	394	484	2796	829
S71-861	ACS variety	4,260	3,750	14.03	15.19	268	409	465	2685	796
Y204H8	546H3 x Y104	4,150	3,570	14.95	13.96	241	466	490	2792	926
S71-681	ACS variety	4,080	3,570	13.96	14.60	256	410	511	2643	828
Y227H8	546H3 x Y127	3,960	3,400	14.28	13.92	239	460	477	2943	947
Mean		4,360	3,750	15.54	14.07	243	444	485	2903	927
LSD (.05)		NS	NS	NS	0.78	17.2	NS	NS	281	115
Coefficient of Variation(%)		14.67	14.81	15.43	4.76	6.10	14.56	11.04	8.33	10.71
F value		NS	NS	NS	4.1**	4.5**	NS	NS	4.2**	4.1**

** Exceeds the 1% point of significance (F = 2.62).

INTERSPECIFIC HYBRIDIZATION

VULGARIS-PROCUMBENS HYBRIDS

Helen Savitsky

Experiments in 1974 were conducted with diploid nematode-resistant plants and with vulgaris-procumbens trisomics. The first two nematode-resistant plants I obtained were pollinated by nematode-susceptible beets and the resistance transferred to F_1 hybrids. Seventy and 30 F_1 diploid nematode-resistant plants, respectively, were obtained from these two original diploid plants. The F_1 hybrids derived from the first diploid plant I selected were propagated in 1974 by sib-mating and by pollination with diploid nematode-susceptible plants. The F_2 progenies of individual F_1 plants are now being tested for nematode resistance. Eight hundred and one plants that were the progenies of 10 F_1 hybrids obtained after sib-mating and progenies of 6 F_1 hybrids pollinated by nematode-susceptible beets were tested. One hundred and sixty-three nematode-resistant plants were selected from these F_2 hybrids. The average rate of resistance transmission was 20.35%. The F_1 plants propagated by sib-mating showed a higher percent of resistance transmission than did the F_1 hybrids after crossing with nematode-susceptible beets.

One thousand six hundred and sixty F_2 plants, the progenies of 28 F_1 hybrids, are now in the first, second, or third test. The rate of resistance transmission varied in individual F_1 plants, but the average rate of resistance transmission in the F_2 generation was higher than in the F_1 generation.

For the first time it was possible to study the frequency of resistance transmission from many diploid plants. We did not know whether the sugarbeet chromosome bearing the segment of B. procumbens chromosome with the gene for nematode resistance is transferred to the next generation, or is thrown out into cytoplasm in many plants. The first results showed that resistance was transferred from all F_1 plants to the F_2 generation. The results obtained are important because they indicated that a sufficient quantity of diploid nematode-resistant plants may be obtained for large scale studies. Different frequencies of resistance transmission manifested by the individual hybrids permit the selection of hybrids with a higher rate of transmission.

The diploid nematode-resistant plants are derived from crossing over in the trivalent chromosome association of resistant trisomics. Crossing over between B. vulgaris and B. procumbens chromosomes is rare and occurs in only a few trivalent associations. This makes it difficult to obtain diploid nematode resistant hybrids. The nematode resistant

trisomics that acquired the chromosome of B. procumbens bearing the gene for resistance are easy bolting, have long petioles, elongated narrow leaves (Fig. 1) and develop tumors. In one experiment, 8 F_1 nematode resistant plants and 15 nematode resistant trisomics were selected after 3 simultaneous tests for resistance at a temperature of 75-80° F. The selected plants continued to grow in the greenhouse at the same temperature. In 6 weeks, all trisomics started to flower, whereas no diploid plants developed seedstalks. The diploid plants resembled normal sugarbeets with short petioles, light soft leaves, and had no tumors. This experiment showed that the gene for easy bolting and the gene for nematode resistance, as well as other genes that are associated with trisomics, are linked in the B. procumbens chromosome. The linkage was broken by crossing over, and a segment of the B. procumbens chromosome bearing the gene for nematode resistance was transferred to the sugarbeet chromosome (Fig. 2).

Future work will involve the development of diploid nematode-resistant lines with a higher rate of resistance transmission. Additional cross overs are needed to reduce the size of the segment of the B. procumbens chromosome acquired by the sugarbeet chromosome. This will facilitate the transmission of the sugarbeet chromosome bearing the gene for resistance.

One new diploid nematode resistant plant derived from irradiation of a trisomic plant was selected in 1974. Progeny of this plant is now being tested for resistance. The progenies of trisomics were also tested for resistance, and new resistant trisomic plants were selected. Some trisomics were irradiated. In 1975 diploid nematode-resistant plants will also be irradiated to induce the breakage of the B. procumbens segment in the chromosome of B. vulgaris.

VULGARES-COROLLINAE HYBRIDS

Helen Savitsky and J. S. McFarlane

Vulgaris-corolliflora hybrids. Fourteen highly resistant plants that showed no curly top symptoms, or very mild symptoms, were selected from 400 B_5 plants that were inoculated three times with a highly virulent strain (Logan) of curly top virus. All selected plants had 18 chromosomes, except one plant that had 18 chromosomes and two fragments from the B. corolliflora chromosome. Transmission of resistance in this generation was low, about 4 percent. The resistant plants were propagated by sib-mating.

B_6 progenies derived from resistant B_5 plants are now being studied for curly top resistance. Three hundred B_6 plants were inoculated with curly top virus for selection of curly top resistant plants.

Vulgaris-trigyna hybrids. Selection for curly top resistance in the B_2 generation is being continued. All B_2 plants were male-sterile and were pollinated by diploid sugarbeets. From 380 plants inoculated three times with curly top virus (Logan strain), 20 curly top resistant plants were selected. The number of chromosomes in the selected plants varied from 25 to 45. The plants of the B_2 generation have many B. trigyna chromosomes. Selection of hybrids will be continued next year. Inoculation and selection of plants in vulgaris-corolliflora and vulgaris-trigyna hybrids was done in cooperation with Dr. McFarlane.

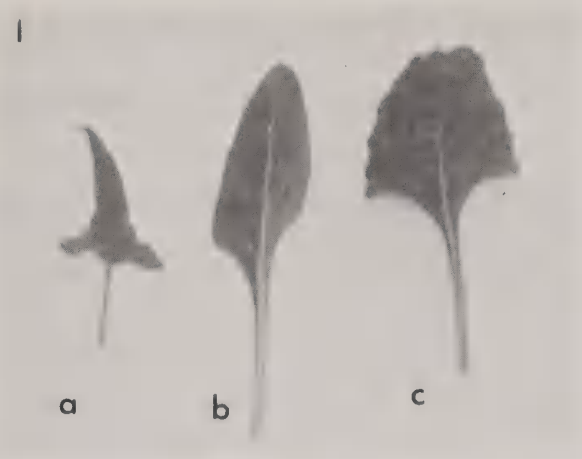

Fig. 1. Leaves of: a) B. procumbens; b) B. vulgaris-B. procumbens nematode resistant trisomic (2n 1 19); c) Diploid nematode resistant sugarbeet (2n 18)

Fig. 2. Flowering nematode resistant trisomics and nonbolting nematode resistant diploid beets that have lost the gene for easy bolting after crossing over between the B. procumbens and B. vulgaris chromosomes.

Fig. 3. Curly top resistant B_5 vulgaris-corolliflora hybrids after three inoculations with curly top virus (Logan strain).

Effect of Powdery Mildew on Sugarbeet Production in the Salinas Valley, California, 1974

I. O. Skoyen, R. T. Lewellen, and J. S. McFarlane

Powdery mildew became an economically important disease in sugarbeets for the first time in California in 1974. The disease was epiphytotic throughout the state within a period of three months. It was observed at the U. S. Research Station, Salinas, California, in mid-June, 1974. Powdery mildew occurred first in the oldest plants (seeded in mid-December, 1973) and spread to successively later seeded beets. The plants appeared to be susceptible to infection only after a canopy of leaves had developed. In beets seeded April 15, 1974, the disease appeared about mid-July, slightly over 3 months after seeding. The rapid spread of powdery mildew in our experimental sugarbeet trials and the heavy fungal growth on mature leaves indicated that the disease probably would affect yield.

The Salinas tests evaluated the effect of powdery mildew on root yield, percent sucrose and root quality of the monogerm hybrid variety US H10. Two tests were conducted in beets seeded April 15 and harvested October 15-18, 1974. The mildew control measures were similar to those found to be effective in Lebanon. Spray applications with wettable sulfur were initiated on July 27, 1974 at a rate of 10 lbs in 200 gal of water per acre at 300 psi. At that time all plants were showing infection, but it was limited to scattered spots on older foliage. Test 1 treatments were no sulfur and repeated applications at 15-16 day intervals; on July 27, August 12 and 28, and September 12, 1974. Plots were 6 rows wide by 125 feet long and were replicated 8 times. In test 2, single spray applications of sulfur were made at intervals following onset of infection. Tests included treated plots and an untreated check strip, each 6 rows wide by 600 feet long. Application dates for test 2 were July 27, August 12 and 28, 1974.

Test 1 was designed to evaluate the damage caused by powdery mildew (Table 1). Four applications of sulfur increased root yield by 6.6 TPA, sucrose by 0.7 percentage point and gross sugar by 2440 lbs per acre. All were highly significant increases. This represented a 38 percent increase in sugar yield per acre over no disease control. Powdery mildew also affected purity and caused significant increases in the NH_2-N and Na concentrations in the roots. The K concentration was not affected.

Test 2 demonstrated the importance of time of application for control of the disease (Fig. 1). The single applications of sulfur on 7/27, 8/12 and 8/28 yielded 3.1, 2.1 and 1.3 tons more roots, respectively, than the check. Root yields for single applications were 47,

32 and 20 percent of that of repeated applications for the respective treatment dates. Sucrose percentage was improved only with early control of the disease. Gross sugar was 21 percent higher than the check for the 7/27 treatment and was reduced to only 11 and 6 percent higher when treatments were delayed two weeks and a month respectively.

Results of our 1974 tests established that powdery mildew on sugarbeets can be very damaging. The effects of the disease on sugarbeet are illustrated in Fig. 2. Nearly complete control of the disease, as evidenced by an almost complete lack of visible powdery mildew, was obtained with repeated spray applications of wettable sulfure. However, reports from throughout the Salinas Valley indicated that sulfur dust was equally effective at a rate of 40 lbs per acre. Timing initial sulfur treatment with the first noticeable scattered patches of the disease on mature foliage appeared to be critical for optimum control. Observation of control effectiveness indicated that a three to four week interval between applications would provide adequate control. Also, in our coastal area, the last application probably could be eliminated without crop loss.

It is probable that powdery mildew, now that it has become established in a broad geographic area, will continue to be an economic factor in sugarbeet production. Present sugarbeet cultural practices and the climate in California insures a continuous source of live host plants that favor the existence of the disease.

Table 1. Test 1. Performance on the US H10 sugarbeet cultivar when sprayed with wettable sulfur for control of powdery mildew.

Treatment	No. Appl.	Acre Yield: Gross Sugar	Acre Yield: Roots	Sucrose	NH_2-N	Na	K
		Pounds	Tons	%	PPM	PPM	PPM
None	0	6350[1/]	20.1	15.78	658	96.8	2465
Sulfur	4	8790	26.7	16.47	542	86.7	2429
LSD (5%)		420	1.4	0.33	30	5.1	NS
Coef. of Var. (%)		5.2	5.6	1.9	4.6	7.4	

[1/] Values are means of 8 replications.

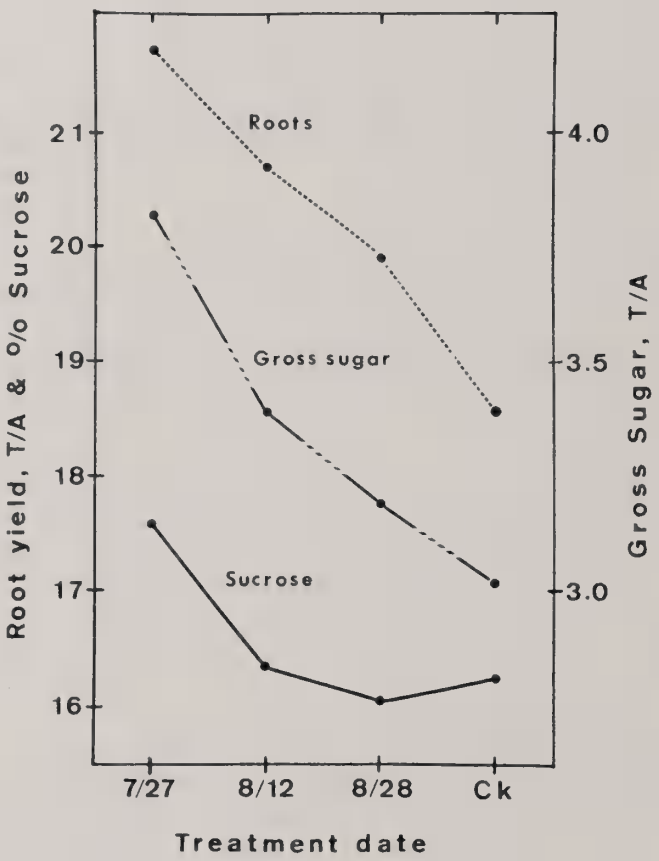

Figure 1: Test 2. Root yield, percent sucrose, and gross sugar for single applications of sulfur on different dates.

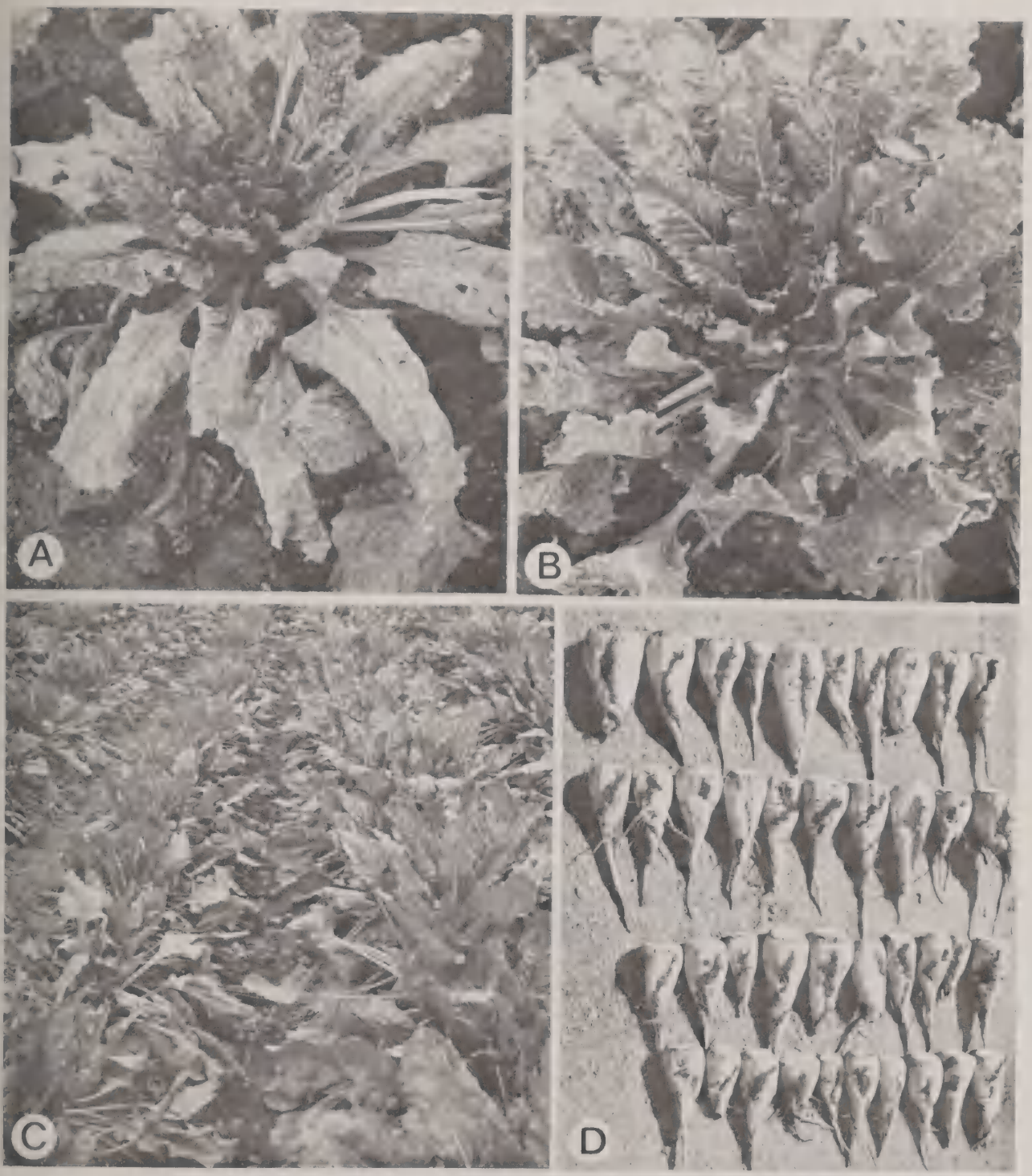

Figure 2. Effects of powdery mildew on sugarbeet: A) untreated plant showing heavy mycelial growth on mature leaves. Note the number of basil leaves that had died or were collapsing. Young leaves were not yet infected by mildew. B) sulfur treated plant. Note shiny healthy foliage and the few leaves that were dead or collapsing. C) rows visible to left untreated and rows to right received four spray applications of sulfur. D) top two rows of roots represent 20 successive roots from a row with repeated sulfur applications and the bottom rows 20 successive roots from the adjacent area of an untreated row. Total root weight for the top two and bottom two rows were 48 lbs and 32 lbs, respectively.

Evaluation of Breeding Lines to Erwinia Infection

R. T. Lewellen and E. D. Whitney

In a test at Salinas, 64 sugarbeet varieties and breeding lines were evaluated for their reaction to Erwinia infection. This two replication test was planted May 9, 1974, as single-row plots, 32 ft. long. Except for wound-inoculation with Erwinia, the test was grown with normal cultural practices. On July 18, when the plants had a nearly fully developed canopy, they were wounded and inoculated with mixed cultures of Erwinia. Wounding was caused by thrusting an 8-inch disc downward into the crown of each plant. This force caused numerous breaks and splits to occur in the leaf, petiole and crown tissue. The bacterial cells were then immediately sprayed into these wounds. After a few days, evidence of bacterial infection was observed in the wounds and systemic symptoms in the petioles soon followed. Systemic infection and rotting were allowed to take their course until the test was harvested.

The plots were harvested and scored for Erwinia infection on October 7 and 8, 1974. A scale developed by Dr. F. J. Hills of 0 to 100% rot per root was used. Each root was individually hand topped and split to determine the extent and amount of rot.

The results of this test are summarized in the table. These data suggest that susceptibility to Erwinia root rot is fairly common within the varieties and breeding lines presently used in California.

We concluded from this test that this method has sufficient reliability to be used to evaluate and select within segregating lines. The data correlate well with data obtained simultaneously or previously in greenhouse and field tests.

Evaluation of breeding lines to Erwinia
following wound-inoculation, Salinas, 1974

Entry	Description	Roots/ 100'	% Healthy Roots	% Rot per Root		
				Rep. 1	Rep. 2	Mean
US H10A	Lot 1231	142	23.1	52.3	44.4	48.4
US H10B	Lot 1068	136	25.3	40.0	34.1	37.1
364H8	F70-546H3 x F66-64	141	37.8	17.0	32.5	24.7
317H52	8522H1 x 813	130	18.1	45.3	42.4	43.9
317H62	8536H1 x 813	119	25.0	36.8	56.3	46.5
317H80	2718H5 x 813	158	29.7	31.0	31.4	31.2
323-1	Inc. 123-1, 223-1	164	11.4	60.4	70.0	65.2
323-2	Inc. 123-2, 223-2	167	15.0	50.6	61.9	56.2
323-3	Inc. 123-3, 223-3	145	4.3	76.2	74.6	75.4
868	Inc. F57-68 (US 75)	175	56.3	13.2	19.6	16.4
3201	F_2B_2(868 x RY)	166	61.5	15.3	6.9	11.1
413C (C13)	Inc. 313	155	14.1	63.1	57.9	60.5
F70-13	Inc. F66-13 (C13)	148	15.8	55.0	67.4	61.2

Entry	Description	Roots/ 100'	% Healthy Roots	% Rot per Root Rep. 1	Rep. 2	Mean
813 (C17)	Inc. 713A	150	16.7	54.6	61.9	58.2
F70-17	Inc. C813 (C17)	163	17.3	60.2	38.5	49.3
F71-17	Inc. F70-17	155	18.2	49.5	60.6	55.1
117T	Inc. 917T	141	5.6	82.6	84.2	83.4
364	Inc. F66-64	141	61.1	2.7	9.0	5.9
F66-64	Inc. 264	161	65.0	12.1	5.5	8.8
RR 8	Erwinia R.S. F70-413	163	48.1	20.1	27.6	23.9
RR 84	Erwinia R.S. F70-413	156	32.0	36.9	34.9	35.9
Y301 (C01)	Inc. Y201	136	51.7	25.4	27.1	26.3
Y303	Inc. Y603	130	57.8	12.2	16.3	14.2
Y204 (C04)	Inc. Y104A,B	155	36.4	30.8	40.1	35.4
Y317	Inc. Y117	142	16.5	54.6	56.2	55.4
Y318	Inc. Y118	152	32.0	20.0	31.4	25.7
Y322	Inc. Y222A	147	20.2	53.6	58.7	56.1
Y328	Inc. Y128	166	22.6	42.4	40.4	41.4
Y329/1	Inc. Y229/1	147	19.1	41.9	51.8	46.9
Y339	O.P. Composite	119	34.2	37.7	28.1	32.9
3773	Inc. 1773a-HGS	128	36.6	22.2	25.0	23.6
3789	2775,6aa x A	139	23.6	43.4	38.4	40.9
3790	2792,3,4,5,7,8aa x A	141	40.0	25.3	25.3	25.3
3791	2791aa x A	102	23.1	46.6	31.3	39.0
2755Ma	1755aa x A	131	14.3	61.7	31.9	46.8
F70-546H3	562H0 x F63-546	139	48.3	22.1	14.6	18.4
3705H3	F66-562H0 x 2705	136	14.9	34.3	21.8	28.1
3705H72B	2718H0 x 2705	155	31.3	38.3	27.7	33.0
3718H3	F66-562H0 x 2718	150	26.0	41.1	35.2	38.1
3718H4	F66-563H0 x 2718	159	24.5	35.2	34.9	35.0
3718H5	F68-564H0 x 2718	142	31.9	28.7	35.6	32.1
3546H72B	2718H0 x F70-546	155	61.6	14.1	12.1	13.1
3536-97H3	F66-562H0 x 8536-97C2rr	155	31.3	32.1	29.9	31.0
3536-97H72	2718H0 x 8536-97C2rr	152	33.0	22.5	28.7	25.6
3565H72	2718H0 x 1565	147	38.3	21.1	26.2	23.7
2554H1	0502H0 x 0554	133	27.1	31.8	42.2	37.0
F66-562H0	562H0 x 562 (K)	147	19.1	45.6	46.0	45.8
3565H0	F67-564H0 x 1565	156	9.0	51.5	66.5	59.0
F70-546	Inc. F63-546	145	58.1	7.6	16.0	11.8
3705H0	2705H0 x 2705	178	42.1	22.3	23.7	23.0
2718	Inc. 1718	152	33.0	30.9	35.6	33.3
2718H0	1718H0 x 1718	172	40.0	20.2	22.8	21.5
3718H0B	2718H0 x 2718	84	22.2	39.8	34.7	37.2
ACS-1	S73-1196	155	40.4	22.3	34.0	28.2
-2	S73-1309	152	52.6	14.7	12.8	13.8
-3	S73-1319	161	34.0	30.5	31.6	31.0
-4	S73-1360	152	42.3	23.5	33.0	28.3
-5	S72-400	147	47.4	24.7	22.7	23.7
-6	S72-381	150	34.4	34.0	24.7	29.3
-7	S72-360	163	24.0	42.0	51.3	46.6
-8	S72-316	172	51.8	16.9	36.1	26.5
-9	S72-320	144	43.5	15.9	27.2	21.5
-10	S72-307	145	46.2	13.1	40.5	26.8
-11	S71-114	141	32.2	36.0	45.4	40.7
					LSD (.05)	13.9

Evaluation of Erwinia Resistant Selections from C413

E. D. Whitney and R. T. Lewellen

Lines derived from Erwinia resistant selections within C413 were evaluated for Erwinia rot in the field in 1974. Polycross seed from selected roots was evaluated as individual lines, e.g., E402-3, or as composites, e.g., E402, where sufficient seed of individual lines was not available. These lines and composites represented two cycles of selection. Within each cycle the roots were evaluated and selected first from the field and subsequently in the greenhouse (see page A59-A60, Sugarbeet Research, 1973 Report).

The seed was planted June 6, 1974 in a completely randomized design with four replications. On August 13 and 27, the plants were inoculated with a mixture of Erwinia isolates. The plants were not injured prior to inoculation. The test was hand-harvested and individual roots were examined and scored for percent rot on October 2, 1974.

In all cases, the lines selected for Erwinia resistance showed less rot than F70-13. The lines with only a single cycle of field and greenhouse selection (E302, E304, E305, and E306) varied from 1.7 to 11.1% rot per root. However, the progeny reselected from these lines using an additional cycle of field and greenhouse selection were uniformly resistant and showed only about 1% rot per root on the average.

Seed from a composite of selected roots designated E434 was crossed with F70-546H3 to produce a hybrid (E434H8) equivalent to US H9B. The data indicate that this hybrid is more Erwinia resistant than US H9B.

These data indicate that lines resistant to Erwinia can be selected from C413. However, the relationships between Erwinia reaction and other characteristics is not known. While selecting for resistance to Erwinia, it may be necessary to keep selection pressure on other desirable traits to prevent their being lessened or lost, e.g., yellows resistance, bolting resistance, yield, etc.

Mean % rot per root of lines selected from C413 for Erwinia resistance, Salinas, 1974

Entry	Description	% Rot/Root
F70-13	Inc. F66-13 (C413)	20.4a
F70-546H3	562H0 x F63-546	6.3bcde
US H9B	546H3 x F70-13	9.6bc
364	Inc. F66-64	7.3bcd
364H8	546H3 x F66-64	4.1cde
E434	2 Field, 2 GH ERS C413	1.7de
E434H8	546H3 x E434	2.7de
E302	1 Field, 1 GH ERS C413	1.7de
E402	2 " , 2 " " "	1.3de
E402-3	2 " , 2 " " "	1.0e
E402-4	2 " , 2 " " "	0.2e
E402-5	2 " , 2 " " "	1.3de
E304	1 Field, 1 GH ERS C413	11.1b
E404-2	2 " , 2 " " "	0.6e
E404-3	2 " , 2 " " "	3.1de
E404-7	2 " , 2 " " "	0.9e
E305	1 Field, 1 GH ERS C413	3.9cde
E405-1	2 " , 2 " " "	0.3e
E306	1 Field, 1 GH ERS C413	2.0de
E406	2 " , 2 " " "	0.8e
E406-2	2 " , 2 " " "	1.5de
-3	2 " , 2 " " "	0.9e
-5	2 " , 2 " " "	1.0e
-8	2 " , 2 " " "	0.6e
-9	2 " , 2 " " "	1.1e
-10	2 " , 2 " " "	0.3e

Means with the same letter are not significantly different (P = 0.05) according to Duncan's multiple range test.

Performance of Russian Varieties and Breeding Lines

J. S. McFarlane

During a 1972 trip to the sugarbeet research centers in the Soviet Union arrangements were made to exchange seed of varieties and breeding lines. We provided seed of 24 varieties developed by sugarbeet breeders located throughout the United States and the Russians provided seed of 24 varieties developed at their sugarbeet breeding stations. Although the Russian varieties were identified only by name and number, we were able to find a description of most varieties in Russian publications. Fifteen of the varieties were diploid multigerms, two were anisoploid multigerms, three were diploid monogerms, and four were anisoploid monogerms. The varieties may be described as follows:

P.I. 381632 Belotserkovsk polyhybrid 2

An anisoploid monogerm variety developed at the White Church breeders station in the Ukraine. Polyploid seed is produced by planting roots of the tetraploid White Church monogerm line with diploid Verchanjackskaja 031. The variety is used in the Ukraine and is more disease resistant (diseases unspecified) than is Belotserkovsk polyhybrid 1.

P.I. 381633 Belotserkovsk polyhybrid 1

An anisoploid monogerm variety developed at the White Church breeding station. Polyploid seed is produced by planting roots of a tetraploid White Church monogerm with diploid Ramonsk 06 in a ratio of 3 tetra:2 diploid. From 70-75% of the plants in the hybrid population have monogerm seed and 65-70% of the seed is triploid.

P.I. 381634 Kirghizian polyhybrid 18

A multigerm anisoploid between tetraploid Ramonsk 023 and diploid Kirghizian 058. The variety combines good yield and sucrose with heat and powdery mildew resistance.

P.I. 381635 Kubanian polyhybrid 9

A multigerm anisoploid between tetraploid Verkhynyachsk 038 and diploid Pervomaisk 028. The variety possesses resistance to Cercospora leaf spot and downy mildew. Root yield and sucrose percentage are improved over former diploid varieties. The variety is widely used in the Krasnodar region.

P.I. 381636 L'govsk 078

A multigerm variety developed at the L'gov. Experimental Breeding Station by individual group selection.

P.I. 381637 Mezhotnensk 070

A multigerm diploid variety developed from hybrids between bolting resistant German and Polish varieties. The variety is characterized by high yield, bolting resistance, high sucrose percentage, and resistance to downy mildew. Grown in Latvian SSR and western Ukraine.

P.I. 381638 Mezhotnensk 080

A multigerm diploid variety developed from a hybrid between Janash 1 and Kleinwanzleben E. Similar to Mezhotnensk 070.

P.I. 381639 Mezhotnensk 104

A multigerm downy mildew resistant variety. Grown in Latvian SSR and western Ukraine.

P.I. 381640 Pervomaisk 028

A multigerm diploid variety resistant to Cercospora leaf spot, high in sugar, and late in maturity. This variety was widely used in the Kuban region but is being replaced by Kubanian polyhybrid 9 and Pervomaisk polyhybrid 10.

P.I. 381641 Pervomaisk polyhybrid 10

An anisoploid monogerm variety developed at the North Caucasus Branch All Union Research Institute of Sugarbeet in Kropotkin. Polyploid seed is produced by planting roots of tetraploid Yaltushkvovsk monogerm with those of diploid Pervomaisk 028. The variety possesses resistance to Cercospora leaf spot and downy mildew.

P.I. 381642 Ramonsk 06

A diploid multigerm variety which is outstanding in sugar yield. The variety has wide adaptation and is used as a standard check in State variety trials throughout USSR.

(All "Ramonsk" varieties were developed at the All Union Research Institute of Sugarbeet and Sugar at Ramon.)

P.I. 381643 Ramonsk 09

A diploid monogerm variety developed at Ramon from monogerm lines selected at the White Church and Yaltushkovsk breeding stations. The variety has been used in the Voronezh region since 1964 but tends to be susceptible to bolting and to root rot.

P.I. 381644 Ramonsk 028

A diploid multigerm variety possessing bolting and drought resistance. The variety matures early and has an erect rosette which facilitates mechanical care and harvesting. This variety has served as a source of CMS.

P.I. 381645 Ramonsk 036

A diploid multigerm variety noted for high productivity.

P.I. 381646 Ramonsk 065

A diploid multigerm variety developed through a system of individual group selection from hybrids between Ramonsk varieties. The variety has been used since 1965.

P.I. 381647 Ramonsk 100

A diploid multigerm variety with high sugar content and refined juice purity.

P.I. 381648 Uladovsk 096

A diploid multigerm variety developed at the Uladovo-Lulinetskaya Experimental Breeding Station.

P.I. 381649 Uladovsk 752

A diploid multigerm variety developed at the Uladovo-Lulinetskaya Experimental Breeding Station.

This is a high yielding variety with good bolting and storage rot resistance.

P.I. 381650 Verkhynyachsk 031

A diploid multigerm variety developed at the Cherkassy State Agricultural Experiment Station. The variety has resistance to storage rot, downy mildew, and bolting.

P.I. 381651 Verkhynyachsk 072

A diploid multigerm variety developed by individual root selection and hybridization. Resistant to storage rot.

P.I. 381652 Verkhynyachsk 098

A diploid multigerm variety developed at the Cherkassy State Agricultural Experiment Station.

P.I. 381653 Uladovsk 20

A monogerm variety developed by individual group selection in combination with mass selection. Exceeds the standard in yield of roots and sugar. The variety has good powdery mildew resistance.

P.I. 381654 Vnisovsk polyhybrid 5

A monogerm, anisoploid variety produced by mixing multigerm diploid with monogerm tetraploid in the seed field. The variety yields well and has good processing qualities.

P.I. 381655 Yaltushkovsk monogerm

A diploid monogerm variety possessing high yield, earliness, and storage-rot resistance.

In addition to the 24 varieties we also exchanged six breeding lines. The six Russian lines may be described as follows:

P.I. 386204 VNIS F-505

Progeny of a single storage rot resistant plant. Selected at the All Union Research Institute for Sugarbeet, Kiev.

P.I. 386205 VNIS F-510

Same as F-505.

P.I. 386206 VNIS F-526

Same as F-505.

P.I. 386207 VNIS F-738

Same as F-505.

P.I. 386208 N2376

A line developed at the Verkhynyachsk Breeding Station. The line possesses powdery mildew resistance and moderate storage rot resistance.

P.I. 386209 N7776

A line developed at the North Caucasus Branch of the All Union Research Institute for Sugarbeet, Kropotkin. The line is the product of individual plant selection for Cercospora leaf spot resistance.

The following tests were made with the Russian varieties and breeding lines:

U.S. Agricultural Research Station
Salinas, California
- Yield trial
- Powdery mildew resistance
- Curly top resistance
- Bolting resistance
- Root rot resistance

Imperial Valley Conservation Research Center
Brawley, California
- Bolting resistance

Crops Research Laboratory
Fort Collins, Colorado
- Yield trial
- Rhizoctonia resistance
- Leaf spot resistance

Crops Research Laboratory
Logan, Utah
- Search for CMS

Sugarbeet Investigations
North Dakota State University
Fargo, North Dakota
- Storage rot resistance

Sugarbeet Investigations
Agricultural Research Center
Beltsville, Maryland
- Leaf spot resistance

American Crystal Sugar Company
- Yield trial - Drayton, North Dakota
- Yield trial - East Grand Forks, North Dakota

Holly Sugar Corporation
- Yield trial - Torrington, Wyoming
- Yield trial - Sidney, Montana

Performance in variety trials--Information on yield and sucrose percentage was obtained from variety trials in five states. Performance varied greatly from one location to another but, in general, the Russian varieties yielded well and had good sucrose. The results of the Salinas, California test (Table 1) were affected by a severe powdery mildew attack. The yield of the mildew susceptible US H10 check variety was reduced 29% in an adjoining test. Losses also occurred with the Russian varieties but undoubtedly were proportionately less severe than with US H10. In the Fort Collins test (Table 2), the Russian varieties tended to perform better than the US H10 check but were inferior to GW MonoHy A1.

In Holly Sugar Corporation tests at Torrington, Wyoming and Sidney, Montana, the US H10 check tended to be intermediate in root yield and a little lower in sucrose percentage than most of the Russian varieties (Tables 3 and 4). Unfortunately, US H10 was the only check included in these two tests. An adapted local check would probably have performed better.

In the two American Crystal tests in the Red River Valley, the local check was intermediate in both root yield and sucrose percentage (Tables 5 and 6). The US H10 check performed well in these two tests, especially for root yield. A range in Amino N and Na was observed among the Russian varieties.

Bolting resistance--The Russian varieties showed a great range in bolting resistance (Tables 1 and 7), but few of the varieties possessed sufficient resistance to permit winter plantings in the coastal valleys of California or September plantings in the Imperial Valley. The varieties Mezhotnensk 070 and 080 showed the best resistance at both Brawley and Salinas. These varieties were developed at the Mezhotnensk Breeding Station for use in Latvia and the western Ukraine.

Leaf spot resistance--The varieties were rated for Cercospora leaf spot resistance at Beltsville and Fort Collins. Infection was relatively light at Fort Collins and no significant differences were observed among varieties (Table 2). A range in resistance was observed at Beltsville but none of the Russian varieties nor the leaf spot resistant breeding line were as resistant as the US H20 variety (Table 8). These results indicate that either different strains of Cercospora occur in Russia or their selection program has been less effective.

Rhizoctonia resistance--Tests at Fort Collins indicated significant differences among the Russian varieties for Rhizoctonia resistance (Table 2). None of the Russian varieties showed a level of resistance approaching that of the Fort Collins selections.

Erwinia root rot resistance--Root rot among varieties in the Salinas test ranged from 0 to 2.1% (Table 1). Most of the rot was identified as Erwinia. Some of the varieties were significantly more susceptible than US H9B and US H10B. None were found to be significantly more resistant than these two varieties.

Powdery mildew resistance--Severe mildew infection occurred in the Salinas test and no attempt was made to control the disease. Infection occurred on all varieties but was more severe on US H9B and US H10B than on any of the Russian varieties (Table 1). Powdery mildew occurs in many of the Russian production areas and resistant selections have been made. These results show that a moderate level of resistance has been incorporated into several of the varieties.

Cytoplasmic male sterility--None of the commercial varieties used in the Soviet Union utilizes CMS. I was told that CMS breeding lines have been developed but we did not receive any of these lines in the exchange program. One of the breeders advised that CMS plants occurred in Ramonsk 023. Dr. Theurer searched unsuccessfully for CMS plants in this variety.

Storage rot resistance--Four of the Russian varieties and five of the breeding lines are described as possessing storage rot resistance. Information provided during my Russian tour indicated that the Russians consider Botrytis to be the most important cause of storage rot and that selections had been made primarily, if not entirely, for resistance to this organism. Dr. Bugbee failed to find a high level of Botrytis resistance among the 24 varieties, but he did observe improved resistance in three of the breeding lines (Table 9).

Monogerm seed--Seven of the 24 varieties were described as possessing monogerm seed. Six of these varieties were examined in the laboratory at Salinas. The proportion of seed possessing the monogerm character ranged from 60% for Vnisovsk polyhybrid 5 to 93% for Ramonsk 09. The anisoploid varieties Belotserkovsk polyhybrid 1 and 2 and Vnisovsk polyhybrid 5 had the lowest percentage of monogerm seed. These varieties are produced by mixing a tetraploid monogerm with a diploid multigerm in the seed field so the resulting seed is a mixture of monogerm and multigerm. Seed produced by this method is widely used in the Soviet Union. The seed characteristics of the Russian monogerm varieties are shown in the following table:

Plant Intro. No.	Variety	Locules per seedball 1	2	3	4	Germ.	Sprouts per seedball
		%	%	%	%	%	No.
632	Belotserkovsk polyhybrid 2	69	27	4	-	78	1.3
633	Belotserkovsk polyhybrid 1	84	10	5	1	74	1.2
643	Ramonsk 09	93	7	-	-	44	1.1
653	Uladovsk 20	85	14	1	-	84	1.2
654	Vnisovsk polyhybrid 5	60	26	11	3	74	1.4
655	Yaltushkovsk monogerm	88	11	1	-	86	1.1

Curly top resistance--Each of the 24 varieties was tested in the greenhouse for curly top resistance. None of the varieties exhibited any resistance. The disease is not known to occur in the Soviet Union.

Virus yellows resistance--Natural yellows infection occurred in the Russian variety test at Salinas, California. Yellows symptoms were more severe on each of the Russian varieties than on US H10. Comparisons were not made between yellows-inoculated and yellows-free plots. Yellows is not a serious disease in the Soviet Union and their varieties have not been selected for resistance.

Future plans--Seed increases are being made of the most promising diploid varieties. Additional tests will be made for root yield and sucrose percentage. Dr. Bugbee is utilizing the Botrytis resistant lines in his storage rot studies. The powdery mildew resistance of some of the Russian varieties may prove useful should we need to incorporate resistance into our curly top resistant varieties.

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Table 1

RUSSIAN VARIETY TEST, SALINAS, CALIFORNIA, 1974

6 replications, 5x5 Balanced lattice — Planted: February 26, 1974

2-row plots, 53 ft. long — Harvested: October 4, 1974

Plant Introduction No.	Variety	Acre Yield Sugar	Beets	Sucrose	Bolting
		Pounds	Tons	Percent	Percent
655	Yaltushkovsk mm	12,700a	38.34ab	16.6efgh	6.4bc
649	Uladovsk 752	12,450ab	37.50abcd	16.6efgh	0.7ij
654	Vnisovsk Polyhybrid 5 mm	12,220abc	38.94a	15.8kl	2.0ghij
645	Ramonsk 036	12,220abc	36.64abcdefg	16.7defgh	0.8ij
634	Kirghizian Polyhybrid 18	12,140abcd	37.06abcdef	16.4ghi	1.4hij
635	Kubanian Polyhybrid 9	12,100abcd	36.55abcdefgh	16.5fgh	4.2def
648	Uladovsk 096	12,080abcd	35.71cdefghij	16.8bcdefg	0.5j
642	Ramonsk 06	12,010abcde	34.65efghij	17.3ab	1.2hij
636	L'govsk 078	11,850bcde	36.34bcdefgh	16.3ghijk	1.0ij
644	Ramonsk 023	11,770bcdef	35.65cdefghij	16.5fgh	5.5cd
651	Verkhynyachsk 072	11,770bcdef	35.40defghij	16.6efgh	2.6fghi
653	Uladovsk 20 mm	11,720bcdefg	37.20abcde	15.8jkl	7.7b
652	Verkynyansk 098	11,640cdefg	35.95bcdefghi	16.2ghijk	1.6ghij
638	Mezhotnensk 080	11,630cdefg	33.12j	17.5a	0.3j
633	Belotserkovsk Polyhybrid 1 mm	11,580cdefgh	35.31defghij	16.4ghi	2.1ghij
650	Verkhynyachsk 031	11,490cdefgh	34.68efghij	16.6efgh	5.8cd
641	Pervomaisk Polyhybrid 10 mm	11,390defgh	35.48defghij	16.0hijk	3.5efg
637	Mezhotnensk 070	11,310efgh	34.26ghij	16.5gh	0.3j
647	Ramonsk 100	11,310efgh	33.88hij	16.7cdefg	5.0cde
632	Belotserkovsk Polyhybrid 2 mm	11,290efgh	34.39fghij	16.4ghi	1.5ghij
639	Mezhotnensk 104	11,290efgh	33.06j	17.2abcde	2.0ghij
Check	US H10B	11,060fgh	35.04defghij	15.9ijkl	0.0j
643	Ramonsk 09 mm	11,000gh	33.57ij	16.4ghi	10.1a
Check	US H9B	10,860h	35.33defghij	15.51	0.0j
640	Pervomaisk 028	10,840h	33.19j	16.4ghij	3.1efgh
Mean		11,670	35.49	16.5	3.0
LSD (.05)		620	2.20	0.5	1.8
Coefficient of Variation (%)		4.6	5.4	2.8	50.5
F value		5.01**	4.10**	6.26**	17.83**

**Exceeds the 1% point of significance (F = 1.98).

NOTE: Means followed by the same letter are not significantly different at the 5% level according to Duncan's multiple range test.

Table 1
RUSSIAN VARIETY TEST, SALINAS, CALIFORNIA, 1974 continued

Plant Introduction No.	Variety	Root Rot	Pow. Mildew	Vigor	Uniformity	Beets/ 100'
		Percent	Grade 1/	Grade 1/	Grade 1/	Number
655	Yaltushkovsk mm	0.0g	3.3	3.8	4.5	142
649	Uladovsk 752	0.0g	4.5	3.5	5.5	124
654	Vnisovsk Polyhybrid 5 mm	0.9cdefg	4.0	3.7	5.2	118
645	Ramonsk 036	0.8abcdefg	5.0	3.8	5.8	119
634	Kirghizian Polyhybrid 18	0.7cdefg	3.8	3.2	5.5	119
635	Kubanian Polyhybrid 9	0.7cdefg	4.0	3.3	5.0	124
648	Uladovsk 096	0.4fg	4.8	3.7	5.5	116
642	Ramonsk 06	1.6abcde	5.0	3.7	5.7	115
636	L'govsk 078	2.1a	5.0	3.7	5.3	116
644	Ramonsk 023	0.6fg	4.7	4.0	5.8	113
651	Verkhynyachsk 072	0.7cdefg	4.8	4.2	5.8	126
653	Uladovsk 20 mm	0.9bcdefg	3.8	3.7	5.0	129
652	Verkynyansk 098	2.0a	5.0	4.0	5.2	122
638	Mezhotnensk 080	0.4efg	4.7	3.8	5.8	123
633	Belotserkovsk Polyhybrid 1 mm	0.5efg	4.3	3.8	5.5	121
650	Verkhynyachsk 031	1.7abc	5.5	4.7	5.3	117
641	Pervomaisk Polyhybrid 10 mm	0.7defg	3.8	3.5	5.0	126
637	Mezhotnensk 070	0.1g	4.8	4.2	5.7	121
647	Ramonsk 100	0.3g	4.3	3.0	5.0	121
632	Belotserkovsk Polyhybrid 2 mm	1.4abcdef	4.0	3.8	4.8	128
639	Mezhotnensk 104	0.7cdefg	5.2	4.3	6.3	116
Check	US H10B	0.7cdefg	7.3	3.8	4.2	138
643	Ramonsk 09 mm	0.5efg	4.2	4.0	5.8	100
Check	US H9B	0.1fg	7.2	3.8	4.2	137
640	Pervomaisk 028	0.4g	4.3	3.7	5.7	117
Mean		0.8	--	--	--	122
LSD (.05)		1.0	--	--	--	10.8
Coefficient of Variation (%)		110.3	--	--	--	7.8
F value		2.85**	--	--	--	4.79**

**Exceeds the 1% point of significance (F = 1.98).

1/ Powdery mildew, vigor, and uniformity rated from 1 = most desirable rating to 10 = least desirable rating.

NOTE: Means followed by the same letter are not significantly different at the 5% level according to Duncan's multiple range test.

Table 2
RUSSIAN VARIETY TEST, FORT COLLINS, COLORADO, 1974

Plt. Int. No.	Variety	Acre Yield			Thin Juice	Leaf Spot		Rhizoctonia	
		Rec. Sugar	Beets	Sucrose	Purity	9/10	9/18	Healthy 1/	D.I. 2/
		Pounds	Tons	Percent	Percent	Grade	Grade	Percent	
632	Belotserkovsk polyhyb. 2 mm	4,580bc	14.97abc	16.63abc	95.12a	4.8a	3.8a	0.4d	5.33abc
633	Belotserkovsk polyhyb. 1 mm	4,560bc	16.46ab	15.50c	94.48a	4.5a	3.8a	7.2cd	4.98bc
634	Kirghizian polyhyb. 18	5,260ab	16.47ab	17.60abc	95.67a	4.8a	3.8a		
635	Kubanian polyhyb. 9	5,120ab	15.80ab	17.90ab	95.42a	4.8a	3.8a	4.9cd	5.10abc
636	L'govsk 078	5,120ab	16.84ab	16.81abc	94.93a	4.5a	3.5a		
637	Mezhotnensk 070	4,720bc	15.44abc	16.69abc	95.45a	4.5a	3.8a	13.5cd	5.30abc
638	Mezhotnensk 080	4,900bc	15.34abc	17.36abc	96.10a	5.5a	3.8a		
639	Mezhotnensk 104	4,300bcd	14.07bc	16.68abc	96.03a	5.5a	4.3a	3.0cd	5.98ab
640	Pervomaisk 028	4,000bcd	13.51bc	16.19bc	95.98a	4.0a	3.5a	14.4cd	4.85bc
641	Pervomaisk polyhyb. 10 mm	4,860bc	16.44ab	16.82abc	94.18a	3.8a	3.5a	11.8cd	4.78c
642	Ramonsk 06	3,440cd	12.32bc	15.62c	95.12a	5.0a	4.0a	4.6cd	4.80bc
643	Ramonsk 09 mm	2,940d	9.97c	16.27bc	94.95a	4.3a	3.5a	0.0d	6.33a
644	Ramonsk 023	4,340bcd	14.60abc	16.41bc	94.67a	6.0a	4.0a	5.0cd	5.03abc
645	Ramonsk 036	5,220ab	17.03ab	16.85abc	95.37a	6.0a	4.0a	19.9bc	4.63c
647	Ramonsk 100	4,140bcd	13.52bc	16.86abc	95.33a	3.3a	3.0a	4.8cd	5.35abc
648	Uladovsk 096	3,940bcd	13.70bc	16.23bc	94.83a	5.0a	4.0a	1.3d	5.90abc
649	Uladovsk 752	4,160bcd	14.36abc	15.94bc	95.72a	5.5a	4.0a	4.6cd	5.50abc
650	Verkhynyachsk 031	4,120bcd	13.45bc	16.89abc	95.37a	3.5a	3.3a	1.6cd	6.10ab
651	Verkhynyachsk 072	5,000b	15.71ab	17.20abc	95.83a	4.3a	3.5a	4.0cd	6.00ab
652	Verkynyansk 098	5,380ab	17.82ab	16.65abc	95.58a	5.5a	4.0a		
653	Uladovsk 20 mm	4,160bcd	13.86bc	16.68abc	94.95a	5.5a	3.5a	0.4d	5.45abc
654	Vnisovsk polyhyb. 5 mm	4,940bc	17.11ab	16.02bc	94.73a	4.5a	3.8a	0.7d	5.23abc
655	Yaltushkovsk mm	4,680bc	15.10abc	17.17abc	94.75a	5.5a	3.5a	6.9cd	5.35abc
Unif. ck	US H10B	4,460bc	14.45abc	17.17abc	94.62a	5.0a	4.0a	2.3cd	5.45abc
Local ck	GW MonoHy A1	6,600a	19.77a	18.57a	95.00a				
LSS ck	Synthetic					5.5a	3.8a		
LSR ck	FC(504x502/2) x SP 6322-0					3.5a	3.5a		
Rh res. ck	FC 701/4							34.3b	2.78d
Rh res. ck	FC 702/4							54.9a	2.13d
Rh res. ck	FC 703							54.2a	2.03d
LSD .05		1,260	3.52	1.34	1.46	1.81	0.67	14.84	1.09
CV %		23.88	20.34	7.00	1.35	18.40	8.81	67.23	15.43

Yield, sucrose, and purity test--5x5 balanced lattice with 6 reps. Leaf spot test--Randomized complete block with 2 reps. Rhizoctonia test--Randomized complete block with 4 reps.

1/ Healthy-Percent = Percentage of plants without Rhizoctonia.

2/ Disease Index: 0 = no signs of infection, 1 = small arrested lesions, ---, 7 = dead.

NOTE: Means followed by the same letter are not significantly different at the 5% level according to

Table 3

RUSSIAN VARIETY TEST, TORRINGTON, WYOMING
By Holly Sugar Corporation

5 replications, 1 row plots
25 feet long, 22 inches between rows

Planted: April 18, 1974
Harvested: October 8, 1974

Plant Introduction No.	Variety	Ext. Sugar/A Pounds	Ext. Sugar/T Pounds	Gross Sugar/A Pounds	Beets/A Tons	Sucrose Percent	Beets/ 100' Number
645	Ramonsk 036	7,189	283.5	8,764	25.4	17.27	117
654	Vnisovsk polyhybrid 5 mm	6,609	279.0	8,078	23.8	17.02	99
640	Pervomaisk 028	6,531	287.4	7,914	22.7	17.42	111
644	Ramonsk 023	6,521	282.2	7,942	23.0	17.21	108
632	Belotserkovsk polyhybrid 2mm	6,507	286.4	7,889	22.7	17.37	113
635	Kubanian polyhybrid 9	6,497	281.6	7,929	23.0	17.19	113
636	L'govsk 078	6,495	284.9	7,892	22.8	17.32	116
651	Verkhynyachsk 072	6,494	298.8	7,758	21.7	17.85	110
642	Ramonsk 06	6,406	283.3	7,803	22.6	17.25	120
647	Ramonsk 100	6,352	285.9	7,713	22.2	17.36	107
646	Ramonsk 065	6,336	290.5	7,649	21.8	17.53	111
633	Belotserkovsk polyhybrid 1mm	6,216	260.0	7,804	23.8	16.34	111
634	Kirghizian polyhybrid 18	6,186	284.5	7,528	21.8	17.30	117
653	Uladovsk 20 mm	6,180	253.2	7,824	24.3	16.05	123
650	Verkhynyachsk 031	6,081	299.4	7,249	20.2	17.87	114
Check	USH10B	5,941	267.6	7,388	22.2	16.64	120
638	Mezhotnensk 080	5,911	299.8	7,053	19.7	17.88	117
655	Yaltushkovsk mm	5,899	276.9	7,247	21.3	17.00	119
652	Verkhynyansk 098	5,845	266.9	7,279	21.9	16.62	113
639	Mezhotnensk 104	5,811	291.5	6,994	19.9	17.57	114
648	Uladovsk 096	5,794	286.8	7,033	20.2	17.39	113
649	Uladovsk 752	5,737	274.5	7,071	20.9	16.92	115
641	Pervomaisk polyhybrid 10 mm	5,710	269.4	7,089	21.2	16.72	119
637	Mezhotnensk 070	5,554	278.1	6,812	20.0	17.06	113
643	Ramonsk 09 mm	4,509	278.5	5,528	16.2	17.07	80
Test Mean		6,132	281.2	7,489	21.8	17.17	113
LSD (.05)		909	19.5	1,027	2.8	0.75	--
Coefficient of Variation (%)		13	6.1	12	11.2	3.81	--
Standard Error of the Mean		325	7.0	367	1.0	0.27	--
F value		2.42**	2.73**	2.72**	3.45**	2.85**	--

** Exceeds the 1% point of significance (F = 1.94).

Table 4

RUSSIAN VARIETY TEST, SIDNEY, MONTANA

By Holly Sugar Corporation

5 replications, 1 row plots — Planted: May 1, 1974

25 feet long, 24 inches between rows — Harvested: September 27, 1974

Plant Introduction No.	Variety	Ext. Sugar/A	Ext. Sugar/T	Gross Sugar/A	Beets/A	Sucrose	Beets/ 100'
		Pounds	Pounds	Pounds	Tons	Percent	Number
642	Ramonsk 06	7,232	277.5	8,881	26.1	17.03	105
649	Uladovsk 752	7,018	267.9	8,731	26.2	16.66	110
644	Ramonsk 023	6,969	277.5	8,551	25.1	17.03	117
633	Belotserkovsk polyhybrid 1 mm	6,938	266.2	8,654	26.1	16.59	105
637	Mezhotnensk 070	6,892	274.7	8,487	25.0	16.92	123
645	Ramonsk 036	6,773	279.4	8,300	24.3	17.11	111
635	Kubanian polyhybrid 9	6,682	264.6	8,350	25.3	16.52	111
636	L'govsk 078	6,560	278.7	8,043	23.5	17.08	108
648	Uladovsk 096	6,535	278.7	8,009	23.4	17.08	108
646	Ramonsk 065	6,465	272.2	7,995	23.8	16.82	102
634	Kirghizian polyhybrid 18	6,421	262.7	8,043	24.4	16.45	109
654	Vnisovsk polyhybrid 5 mm	6,414	263.1	8,029	24.4	16.47	115
651	Verkhynyachsk 072	6,402	283.3	7,805	22.6	17.26	108
652	Verkhynyansk 098	6,387	269.6	7,925	23.7	16.72	109
632	Belotserkovsk polyhybrid 2 mm	6,379	271.9	7,889	23.4	16.82	107
638	Mezhotnensk 080	6,369	296.4	7,635	21.5	17.76	100
650	Verkhynyachsk 031	6,343	288.7	7,680	22.0	17.47	112
639	Mezhotnensk 104	6,230	289.3	7,535	21.5	17.49	115
Check	USH10B	6,214	258.3	7,830	24.0	16.27	113
653	Uladovsk 20 mm	6,112	262.6	7,656	23.3	16.45	110
655	Yaltushkovsk mm	6,095	264.5	7,605	23.0	16.52	113
641	Pervomaisk polyhybrid 10 mm	5,997	268.4	7,453	22.3	16.67	108
640	Pervomaisk 028	5,914	275.0	7,289	21.5	16.93	105
647	Ramonsk 100	5,872	269.6	7,289	21.8	16.72	103
643	Ramonsk 09 mm	5,020	271.9	6,207	18.4	16.82	93
Test Mean		6,409	273.3	7,915	23.5	16.87	109
LSD (.05)		798	11.4	969	2.9	0.45	--
Coefficient of Variation (%)		11	3.6	11	10.7	2.34	--
Standard Error of the Mean		285	4.1	346	1.0	0.16	--
F value		2.57**	5.32**	2.66**	2.99**	5.20**	--

** Exceeds the 1% point of significance (F = 1.96).

Table 5

RUSSIAN VARIETY TEST, DRAYTON, NORTH DAKOTA

By American Crystal Sugar Company

6 replications, 5x5 Balanced Lattice
2 row plots, 35 ft. long, 22 in. rows

Planted: June 4, 1974
Harvested: October 6, 1974

Plant Int. No.	Variety	Acre Yield: Gross Sugar	Acre Yield: Recov. Sugar	Beets	Sucrose	Amino N	Na	K	Impurity Index
		Pounds	Pounds	Tons	Percent	PPM	PPM	PPM	
648	Uladovsk 096	4680a	4020a	16.00a	14.67abcde	412abc	658bcde	483b	937bcde
Check	US H10B	4460ab	3810ab	15.69ab	14.12defg	492abc	529g	433b	991abcd
645	Ramonsk 036	4350abc	3700abc	15.16abc	14.27bcdefg	487abc	696bc	405b	1005abcd
655	Yaltushkovsk mm	4280abcd	3630abcd	15.03abcd	14.34bcdefg	502ab	640bcdefg	427b	1013abcd
652	Verkhynyansk 098	4220abcde	3620abcd	14.54abcde	14.52abcdef	460abc	558defg	425b	955bcde
635	Kubanian polyhyb. 9	4210abcde	3640abcd	14.26abcde	14.72abcd	452abc	597cdefg	1110ab	909bcde
649	Uladovsk 752	4140abcde	3530abcd	14.50abcde	14.21cdefg	423abc	614bcdefg	522b	975abcde
636	L'govsk 078	4130abcde	3590abcd	13.98abcde	14.89ab	424abc	560defg	1067ab	875de
637	Mezhotnensk 070	4110abcde	3560abcd	14.01abcde	14.67abcde	395bc	647bcdef	286b	905bcde
644	Ramonsk 023	4060abcde	3500abcd	13.84abcde	14.70abcd	429abc	648bcdef	347b	919bcde
642	Ramonsk 06	4060abcde	3490abcd	14.12abcde	14.43abcdef	429abc	628bcdefg	350b	934bcde
632	Belotserkovsk polyhyb. 2mm	4010bcde	3400bcd	13.75abcde	14.49abcdef	505ab	669bcd	616b	1030abc
651	Verkhynyachsk 072	4010bcde	3470abcd	13.56bcde	14.83abc	471abc	532fg	1133ab	902cde
638	Mezhotnensk 080	3940bcde	3450bcd	13.11cde	14.98a	389c	588cdefg	622b	843e
	Local check	3870bcde	3330bcd	13.58bcde	14.27bcdefg	468abc	546efg	1501a	926bcde
654	Vnisovsk polyhyb. 5mm	3850bcde	3210cd	13.91abcde	13.91fg	475abc	797a	683b	1105a
650	Verkhynyachsk 031	3820bcde	3290bcd	12.66e	14.97a	520a	617bcdefg	724b	941bcde
646	Ramonsk 065	3820bcde	3310bcd	13.11cde	14.63abcde	426abc	574defg	314b	900cde
639	Mezhotnensk 104	3800bcde	3300bcd	12.64e	14.97a	472abc	618bcdefg	548b	888cde
633	Belotserkovsk polyhyb. 1mm	3780cde	3160cd	13.65bcde	13.80g	500abc	726ab	632b	1096a
647	Ramonsk 100	3780cde	3190cd	13.52bcde	14.04efg	513a	638bcdefg	496b	1045ab
634	Kirghizian polyhyb. 18	3770cde	3230cd	13.26cde	14.18defg	441abc	618bcdefg	395b	968abcde
641	Pervomaisk polyhyb. 10 mm	3730cde	3160cd	13.19cde	14.19defg	474abc	642bcdefg	585b	1030abc
653	Uladovsk 20mm	3660de	3100d	12.79de	14.23cdefg	502ab	641bcdefg	506b	1022abc
640	Pervomaisk 028	3600e	3060d	12.59e	14.26cdefg	517a	595cdefg	457b	1013abcd
Mean		4010	3430	13.86	14.45	463	623	603	965
LSD (.05)		544	467	1.91	0.52	90.8	94.0	698	115
Coefficient of Variation (%)		11.85	11.88	12.03	3.15	17.1	13.2	101	10.4

NOTE: Means followed by the same letter are not significantly different at the 5% level according to Duncan's multiple range test.

Table 6
RUSSIAN VARIETY TEST, EAST GRAND FORKS, MINNESOTA
By American Crystal Sugar Company

6 replications, 5x5 Balanced Lattice
2 row plots, 35 ft. long, 22 in. rows

Planted: May 30, 1974
Harvested: September 20, 1974

Plant Int. No.	Variety	Acre Yield: Gross Sugar	Acre Yield: Recov. Sugar	Beets	Sucrose	Amino N	Na	K	Impurity Index
		Pounds	Pounds	Tons	Percent	PPM	PPM	PPM	
648	Uladovsk 096	4420a	3700a	16.02ab	13.88abcd	532hi	1254cdef	2251ab	1069fg
649	Uladovsk 752	4400a	3610ab	16.02ab	13.73abcdef	607cdefgh	1333bcde	2471a	1194abcdef
634	Kirghizian polyhyb. 18	4350ab	3560abc	16.19a	13.41abcdefg	606cdefgh	1452ab	2280ab	1220abcde
636	L'govsk 078	4290abc	3520abc	15.64ab	13.69abcdef	677abc	1316bcde	2245ab	1195abcdef
645	Ramonsk 036	4280abc	3510abc	16.04ab	13.39bcdefg	607cdefgh	1355abcde	2323ab	1192abcdef
651	Verkhynyachsk 072	4260abc	3470abcd	15.18abcd	14.01ab	731a	1301bcde	1975ab	1225abcde
653	Uladovsk 20mm	4230abcd	3440abcd	15.85ab	13.38bcdefg	652abcde	1326bcde	2472a	1256abcd
637	Mezhotnensk 070	4230abcd	3510abc	15.61abc	13.60abcdef	588cdefghi	1342bcde	2140ab	1134cdef
642	Ramonsk 06	4190abcd	3490abc	15.09abcd	13.84abcd	578efghi	1349bcde	2294ab	1142bcdef
639	Mezhotnensk 104	4180abcd	3500abc	14.88abcd	14.12a	608cdefgh	1222ef	2184ab	1074fg
Check	US H10B	4170abcd	3490abc	15.53abc	13.48abcdefg	549ghi	1086f	2321ab	1078fg
	Local check	4110abcd	3430abcde	15.57abc	13.19defg	558fghi	1254cdef	2008ab	1098efg
635	Kubanian polyhyb. 9	4070abcd	3300abcde	15.53abc	13.09efg	647abcdef	1442abc	2337ab	1284a
652	Verkhynyansk 098	4030abcde	3350abcde	14.66abcd	13.75abcde	579defghi	1223ef	1948ab	1125defg
640	Pervomaisk 028	3970abcde	3280abcde	14.54abcd	13.69abcdef	628bcdefg	1209ef	1989ab	1167abcdef
650	Verkhynyachsk 031	3950abcde	3240bcdef	14.43abcd	13.69abcdef	698ab	1361abcde	2240ab	1219abcde
633	Belotserkovsk polyhyb. 1mm	3940abcde	3170bcdef	15.21abcd	13.03fg	635bcdefg	1535a	2311ab	1296a
644	Ramonsk 023	3910abcde	3240bcdef	14.01bcd	13.94abc	601cdefgh	1241def	2378a	1129cdefg
654	Vnisovsk polyhyb. 5mm	3900abcde	3150cdef	15.09abcd	12.90g	607cdefgh	1454ab	2429a	1296a
655	Yaltushkovsk mm	3890abcde	3220bcdef	14.24abcd	13.65abcdef	572efghi	1266bcdef	2076ab	1165abcdef
638	Mezhotnensk 080	3800bcde	3220bcdef	13.48cd	14.12a	504i	1234ef	2168ab	1001g
647	Ramonsk 100	3790cde	3110cdef	14.12abcd	13.42abcdefg	639bcdefg	1257cdef	2328ab	1187abcdef
632	Belotserkovsk polyhyb. 2mm	3770cde	3030def	14.28abcd	13.27cdefg	669abcd	1373abcde	1934ab	1272ab
641	Pervomaisk polyhyb. 10	3690de	2980ef	14.06abcd	13.11efg	658abcde	1429abcd	2365a	1289a
643	Ramonsk 09 mm	3490e	2820f	13.10d	13.36bcdefg	628bcdefg	1393abcde	1657b	1263abc
Mean		4050	3330	14.97	13.55	614	1320	2205	1183
LSD (.05)		449	372	1.75	0.58	74.6	156	569	113
Coefficient of Variation (%)		9.68	9.76	10.22	3.74	10.6	10.3	22.6	8.3

NOTE: Means followed by the same letter are not significantly different at the 5% level according to Duncan's multiple range test.

Table 7
RUSSIAN VARIETY BOLTING RESISTANCE TEST, BRAWLEY, CALIFORNIA, 1974

2 replications, Randomized block — Planted: September 25, 1973
1-row plots, 40 ft. long — Counted: May 15, 1974

Plant Introduction No.	Variety	Percent Bolters
Check	US H10B	0.0
637	Mezhotnensk 070	0.0
638	Mezhotnensk 080	1.4
649	Uladovsk 752	7.7
639	Mezhotnensk 104	7.8
648	Uladovsk 096	10.5
636	L'govsk 078	23.4
645	Ramonsk 036	27.4
634	Kirghizian Polyhybrid 18	28.4
652	Verkynyansk 098	29.8
651	Verkhynyachsk 072	30.5
642	Ramonsk 06	30.5
650	Verkhynyachsk 031	31.1
646	Ramonsk 065	35.6
643	Ramonsk 09 mm	35.9
644	Ramonsk 023	38.3
633	Belotserkovsk Polyhybrid 1 mm	38.7
632	Belotserkovsk Polyhybrid 2 mm	39.1
647	Ramonsk 100	42.8
635	Kubanian Polyhybrid 9	44.1
640	Pervomaisk 028	49.6
654	Vnisovsk Polyhybrid 5 mm	51.6
641	Pervomaisk Polyhybrid 10 mm	55.5
653	Uladovsk 20 mm	66.1
655	Yaltushkovsk mm	70.3
Mean		31.8
LSD (.05)		3.9
Coefficient of Variation (%)		20.9
F value		17.05**

**Exceeds the 1% point of significance (F = 2.67).

Table 8

Russian Variety Leaf Spot Resistance Evaluation Test, Beltsville, Maryland

By G. E. Coe

Plant Intro. No.	Variety	Leaf spot grade[1/] 8/8	8/16	8/23
641	Pervomaisk polyhybrid 10 mm	3.3	3.7	4.3
209	N7776	3.3	3.7	4.3
655	Yaltushkovsk monogerm	3.7	4.0	4.3
635	Kubanian polyhybrid 9	3.7	3.7	4.7
633	Belotserkovsk polyhybrid 1 mm	3.7	4.3	5.0
640	Pervomaisk 028	4.0	4.0	5.0
643	Ramonsk 09 mm	4.0	4.0	5.0
654	Vnisovsk polyhybrid 5 mm	4.0	5.0	5.0
632	Belotserkovsk polyhybrid 2 mm	4.3	4.7	5.0
653	Uladovsk 20 mm	3.7	4.3	5.3
647	Ramonsk 100	4.3	4.3	5.3
652	Verkhynyansk 098	3.7	4.3	5.7
634	Kirghizian polyhybrid 18	4.0	5.0	5.7
636	L'govsk 078	4.3	4.7	5.7
637	Mezhotnensk 070	4.3	4.7	5.7
645	Ramonsk 036	4.7	5.3	5.7
646	Ramonsk 065	4.7	5.3	5.7
649	Uladovsk 752	4.3	5.7	6.0
651	Verkhynyachsk 072	4.7	4.7	6.0
644	Ramonsk 023	4.7	5.3	6.0
648	Uladovsk 096	4.7	5.7	6.0
638	Mezhotnensk 080	4.3	5.0	6.3
650	Verkhynyachsk 031	4.7	5.3	6.3
639	Mezhotnensk 104	5.0	5.7	6.3
642	Ramonsk 06	5.0	5.7	6.3
	US H20	3.3	3.3	3.7
	(71550-01 x EL38) x EL40	3.3	3.3	4.0

[1/] Leafspot rated on a scale of 0 to 10 with 0 = no spots and 10 = death of all leaves. Each rating is an average of three replications.

Table 9
Evaluation of Russian Varieties for Resistance
to Storage Rot, Fargo, North Dakota

By W. M. Bugbee

Plant Introduction No.	Variety	Botrytis		Phoma	
		Susc. No.	Res. No.	Susc. No.	Res. No.
632	Belotserkovsk polyhybrid 2 mm	16	0	16	0
633	Belotserkovsk polyhybrid 1 mm	16	5	21	0
634	Kirghizian polyhybrid 18	32	0	28	4
635	Kubanian polyhybrid 9	13	4	15	2
636	L'govsk 078	58	0	57	1
637	Mezhotnensk 070	56	0	55	1
638	Mezhotnensk 080	16	0	15	1
639	Mezhotnensk 104	17	3	19	1
640	Pervomaisk 028	40	3	39	4
641	Pervomaisk polyhybrid 10 mm	34	3	33	4
642	Ramonsk 06	18	1	18	1
643	Ramonsk 09 mm	19	0	17	2
644	Ramonsk 023	13	0	8	5
645	Ramonsk 036	19	0	13	6
646	Ramonsk 065	6	1	7	0
647	Ramonsk 100	37	1	38	0
648	Uladovsk 096	20	0	20	0
649	Uladovsk 752	41	0	41	0
650	Verkhynyachsk 031	30	0	29	1
651	Verkhynyachsk 072	54	1	50	5
652	Verkhynyansk 098	12	0	11	1
653	Uladovsk 20 mm	45	0	40	5
654	Vnisovsk polyhybrid 5 mm	50	0	50	0
655	Yaltushkovsk mm	13	0	13	0
204	VNIS F-505	41	0	39	2
205	VNIS F-510	22	9	31	0
206	VNIS F-526	12	2	7	7
207	VNIS F-738	13	13	12	14
208	N 2376	10	13	19	4
	701/4 (Local check)[1/]	10	5	2	13
	70P23 (Local check)[2/]	47	3	36	14

[1/] Third cycle of selection for Phoma in FC 701/4.

[2/] Second cycle of selection for Phoma and first for Botrytis in 70P23 from East Lansing.

NEMATOLOGY STUDIES

Laboratory screening of experimental nematicides for control of Heterodera schachtii.

Water solutions of Bunema M (40% potassium N-hydrocymethyl-N-methyldithiocarbamate) supplied by Buckman Laboratories, Inc., Memphis, Tennessee, were tested for lethal effects on unhatched larvae of Heterodera schachtii. Concentrations of Bunema M tested were: 1, 5, 10, 50, 100, 500, 1000, and 2000 ppm. Cysts obtained from infected plants grown in a greenhouse were treated 2 weeks with nematicide solutions and placed in several changes of tap water. The cysts were then placed in sugarbeet root diffusate to stimulate hatching and emergence of larvae as a means of assessing the effects of the chemical treatments. Counts of emerged larvae are listed in Table 1.

Although 10 ppm Bunema M gave some decrease in hatching, increasing the concentration to 50 ppm resulted in a strong nematicidal activity. It is concluded that Bunema M shows about the same activity on H. schachtii as did Bunema (see Sugarbeet Research 1973 Report).

Experimental chemicals supplied by Shell Development Co., Modesto, California, have shown nematicidal activity against species of root knot nematode. These materials were tested to evaluate their effects on Heterodera schachtii. The initial test in our screening program is designed to evaluate the effects of chemicals on hatching and emergence of larvae from nematode cysts. In this test, selected cysts were treated 1 week with 1, 5 or 10 ppm of 5 chemicals, 4 days in several changes of tap water, and 4 weeks in sugarbeet root diffusate to evaluate the viability of treated cysts. The chemicals were initially dissolved in acetone as 1000 ppm solutions and then diluted with water for testing. Groups of 20 cysts replicated 4 times were treated as indicated in Table 2.

Counts of hatched larvae revealed that none of the chemicals reduced the viability of cyst contents to a degree that would warrent further testing.

Water solutions of an organophosphate nematicide, CGA-12223, supplied by Ciba-Geigy Corp., Ardsley, NY, was tested in concentrations of 1, 10, 50, 100, 250, and 500 ppm for initial and residual effects on hatching of H. schachtii. Results of this test are listed in Table 3.

Counts of hatched larvae revealed that although 10 ppm of CGA-12223 depressed hatching, subsequent hatching in diffusate was nearly inversely proportional to the concentration between the ranges of 10-250 ppm. A 10 percent granular formulation of this material may be tested in the greenhouse for control of H. schachtii on sugarbeet.

Data provided by Syntex Inc., Palo Alto, California, showed stimulation of hatching of H. schachtii by their experimental Compound RS-5866. Consequently, a test was initiated to test the effects of 0.01, 0.1, 0.5, 1.0, 5.0, 10 and 100 ppm of RS-5866 on hatching of H. schachtii.

Counts of larvae listed in Table 4 indicate that 1.0 ppm gave only a slight increase in hatching suggesting that this material does not have sufficient activity to warrant further testing.

Reports in literature have shown that Tagetes spp or their extracts are nemastatic or nematicidal to a number of nematode species. Solvents of unlike polarity were used to obtain extracts of Tagetes. Listed in the order of increasing polarity with the amount of fresh dry weight extracted the solvents were: Shelly B (45-56°) - 1 gm/ml of Extract A; 95% ethyl ether (neutral fraction) - 2 gm/ml of Extract B; 95% ethyl ether (acidic fraction) - 2 gm/ml of Extract D. These stock solutions were diluted to concentrations listed in Table 5 and tested for their effects on hatching and emergence of larvae from cysts of Heterodera schachtii.

Results show that the highest concentration of Extracts A, B and C almost completely prevented hatching whereas Extract D (extracts with water) showed less activity.

Cooperator - Bock Chan, U.S.D.A., Western Regional Research Lab., Berkeley, CA.

Attempts to isolate and identify hatch factors in sugarbeet root diffusate

A project to isolate and identify the hatch factor in sugarbeet root diffusate has been initiated in cooperation with ARS chemists in Berkeley, California. Since June of 1974, twenty hatching tests, which included 1433 samples, have been conducted to assay the presence or absence of hatch factor. The tests have established that large quantities of diffusate which are free of soil contaminants can be obtained by growing seedlings hydroponically. Bioassay of fractions indicate there are probably three active components in the diffusate. This project will be continued through 1975. At the end of this time, the project will be re-evaluated to determine if progress has been sufficient to warrant its continuation.

Cooperators - Achem Burkhardt and Anthony Weiss, ARS Western Regional Research Lab., Berkeley, CA.

Evaluation of resistance of interspecific hybrids Beta vulgaris X B. procumbens to Heterodera schachtii

Trisomic and diploid interspecific hybrids of Beta vulgaris X B. procumbens which had shown resistance in three consecutive screening tests were evaluated to determine the qualitative and quantitative aspects of the resistance. In this study, three tests were conducted. US 75 sugarbeet and resistant hybrids were inoculated with 30 cysts/plant and allowed to grow 30 days in a growth chamber at 24 C (Table 6) or 40 days in a greenhouse (Table 7). Counts of larvae in all stages of development and adult nematodes were obtained by washing and staining plant roots and by examining debris obtained by washing and screening soil. For histological studies, the roots were embedded in a parafine, sectioned with a microtome and stained in saffranin and fast green.

Examination of roots revealed that cessation of development of Heterodera schachtii larvae in roots of resistant hybrids may occur at any stage, but most frequently occurs at the 2nd and 3rd developmental stages. Resistance is transferred from trisomics and from newly developed sugarbeet obtained from trisomics to 10-15% of the viable progeny. Table 6 shows that trisomic and diploid plants have about the same level of resistance.

In a third test, three populations of Heterodera schachtii were inoculated on resistant trisomics and susceptible diploids which were the progeny of resistant triploid X susceptible B. vulgaris. The nematode populations evaluated were: a population imported from the Netherlands, a population obtained from the Salinas Valley of California, and a population recovered from resistant hybrids in the aforementioned tests.

Nematode counts listed in Table 7 show that diploid progeny were indeed highly susceptible whereas the trisomics exhibited a high degree of resistance to the three nematode populations.

Histological studies revealed that when nematodes develop to maturity in roots of resistant plants, typical syncytia develop. When larvae do not develop to maturity, cessation of development is attended by early collapse of syncytia, necrosis which may be locally restricted or wide spread, frequently extending from the stele to the root surface and several millimeters in length. In areas adjacent to infection loci, hyperplastic changes may result in extensive disorganization of host plant tissues.

Cooperators - Drs. Helen Savitsky and James Read.

Table 1. Influence of treatment of Heterodera schachtii cysts 2 weeks with Bunema M followed by 2 weeks with sugarbeet root diffusate on hatching and emergence of larvae.

Conc. Bunema M (ppm)	2 weeks in Bunema M	2 weeks in diffusate	Total Hatch
0[1/]	1228[2/]	2478[2/]	3721[2/]
1	996	2250	3246
5	630	2351	2981
10	630	1457	2086
50	16	13	29
100	21	1	22
500	24	2	26
1000	4	1	5
2000	9	1	9
Beet root diffusate[3/]	--	3835	3835

[1/] Treated 2 weeks with tap water followed by 2 weeks with diffusate.

[2/] Mean numbers of larvae emerged from 4 replications of 25 cysts.

[3/] Treated 4 weeks with sugarbeet root diffusate.

Table 2. Influence of experimental nematicides on hatching and emergence of larvae from cysts of Heterodera schachtii[1].

Treatment	Conc. (ppm)	Hatch in chemical	Hatch in water	Hatch in diffusate	Total Hatch
Water	--	357[2]	5[3]	1206[4]	1568
Acetone	10	243	4	1331	1578
SD 33451	1	300	0	1800	2100
	5	194	3	1668	1865
	10	213	1	1766	1980
SD 33992	1	260	4	1688	1952
	5	490	2	1063	1555
	10	272	16	1081	1369
SD 34042	1	489	8	1685	2182
	5	462	4	1514	1980
	10	209	6	1605	1820
SD 34046	1	360	6	1684	2050
	5	407	2	1532	1941
	10	226	1	1519	1746
SD 34110	1	536	4	1813	2353
	5	315	4	1646	1965
	10	77	1	1710	1788

[1] Each figure is a mean of 4 replications of 20 cysts.

[2] Cysts treated 1 week in water solutions of chemicals.

[3] Cysts treated 4 days with tap water after chemical treatment.

[4] Cysts treated 4 weeks with sugarbeet root diffusate.

Table 3. Effects of CG 12223[1] on hatching and emergence of larvae from cysts of Heterodera schachtii.

Conc. CGA 12223 (ppm)	In chemical 7 days	In water 4 days	In diffusate 4 weeks	Total hatch[2]
500	5	1	9	14
250	7	0	407	414
100	33	1	3446	3480
50	7	0	4335	4342
10	11	46	5895	5951
1	379	172	7548	8099
0[3]	380	103	6643	7126
0[4]	3802	1216	2102	7120

[1] Solutions prepared from emulsifiable concentrate.

[2] Total hatch from 4 replications, each of 20 cysts.

[3] Cysts treated continuously with tap water.

[4] Cysts treated continuously with sugarbeet root diffusate.

Table 4. Influence of RS 5866 on hatching and emergence of Heterodera schachtii.

Conc. (ppm)	Mean Hatch 1/	Conc. (ppm)	Mean Hatch 1/
100	731.4	0.5	570.6
10	630.6	0.1	740.2
5.0	766.8	0.01	758.8
1.0	997.8	0	627.8

1/ Mean hatch from 5 replications of 20 cysts.

Table 5. Effects of extracts of Tagetes on hatching and emergence of larvae from cysts of Heterodera schachtii

Treatment	Percent Concen.	Hatch in Treatment	Hatch in diffusate	Total Hatch 2/
Water	-	600	574	1174
Extract A	10	2	4	6
Extract A	1.0	70	1609	1679
Extract A	0.1	805	992	1797
Extract B	10	0	1	1
Extract B	1.0	1	627	628
Extract B	0.1	20	623	643
Extract C	10	1	1	2
Extract C	1.0	7	886	893
Extract C	0.1	16	757	773
Extract D	10	3	990	993
Extract D	1.0	59	1424	1483
Extract D	0.1	543	1313	1856
Sugarbeet root diffusate	-	3232	205	3437

1/ Cysts were treated 2 weeks in water solutions of extracts and 3 weeks in diffusate.

2/ Each figure is the total hatch obtained from 20 cysts.

Table 6. Mean numbers of Heterodera schachtii recovered from Beta vulgaris L. and from B. vulgaris-B. procumbens trisomics and diploids.

Plant Genotype	Number of days after inoculation	2nd stage larvae	3rd stage larvae	4th stage larvae	Total Larvae	Adult Males	Adult Females	Total Adults	Total Nemas
			Test #1						
Vulgaris - procumbens trisomics	15	12	1	0	13	0	0	0	13
	30	39	23	35	97	2	9	11	108
	45 [1/]	14	16	18	48	3	7	10	58
B. vulgaris	15	18	4	0	22	0	0	0	22
	30	38	67	121	122	16	176	242	364
	45	42	13	17	72	12	641	653	725
			Test #2						
B. vulgaris - diploids with segment of B. procumbens chromosome	15	39	46	9	94	0	0	0	94
	30	2	1	0	3	0	5	5	8
	45	21	18	2	41	3	4	7	48
B. vulgaris	15 [1/]	37	33	9	79	0	0	0	79
	30	1	1	2	4	7	299	306	310
	45	2	2	5	9	9	730	739	748

1/ Mean of 4 plants. All other figures are means of 5 plants.

Table 7. Numbers of mature Heterodera schachtii females on roots of sugarbeet and interspecific hybrids 40 days after inoculation with 30 cysts/plant.

Plant Genotype	Nematode Population: Netherlands	Salinas	Isolate[1/]	Mean of all populations[2/]
Trisomics	41.3	11.3	21.2	23.9
Diploids	4383.5	1172.0	3031.8	3016.1
US-75	2708.0	1725.0	2543.7	2328.9

[1/] Population recovered from resistant trisomic hybrids.

[2/] Numbers of plants represented by means are as follows: Trisomics - 19; Diploids - 11; US-75 - 30.

ABSTRACTS OF PAPERS APPROVED FOR PUBLICATION

STEELE, A. E. and L. R. HODGES. The Influence of Aldicarb in Water Solutions and in Soil on Survival and Development of Heterodera schachtii. Nematropica 4: 18-19. 1974.

Water solutions of 10-1000 ppm aldicarb or its oximes, aldicarb sulfoxide or aldicarb sulfone, inhibited hatching of Heterodera schachtii. Hatching and emergence of larvae occurred from cysts removed from the aldicarb solutions and treated 4 weeks in sugarbeet root diffusate. Addition of hatching agents (zinc chloride or sugarbeet root diffusate) to the aldicarb solutions did not decrease inhibition of hatching by aldicarb. Treatments of newly hatched larvae of H. schachtii with 10-1000 ppm aldicarb significantly reduced subsequent development of larvae on sugarbeet. Similar treatments of aldicarb sulfoxide or aldicarb sulfone were less effective in decreasing larval development. Survival and development of treated larvae are inversely proportional to the concentration and duration of aldicarb treatments. Development of H. schachtii on sugarbeet inoculated with viable cysts and grown in aldicarb treated soil is inversely proportional to the concentration of aldicarb in the tested range of 0.75-6.0 parts of aldicarb per million of soil. Culture of H. schachtii on root slices of red table beet grown in soil treated with aldicarb, revealed that the concentration of aldicarb in storage roots was sufficient to prevent development of the nematode on root slices from 6 of 8 plants, whereas only 2 nematodes developed on each of 3 out of 6 root slices obtained from 3 treated plants. Root slices from plants grown in untreated soil averaged 192 developing nematodes per slice 25 days after inoculation.

STEELE, ARNOLD E. Population dynamics of Heterodera schachtii on Lycopersicon esculentum and Beta vulgaris. (Accepted for publication by J. Nematology).

Experiments showed that development of male and female Heterodera schachtii on tomato and sugarbeet are disproportionately influenced by the nematode inoculum level and root size which together determine the density of invading larvae. Slight overcrowding favored development of males over females, whereas severe overcrowding equally affected development of males and females. Differential population changes of host-selected races on tested cultivars was attributable to selective development of male and female nematodes.

STEELE, A. E., and H. SAVITSKY. Quantitative and qualitative evaluation of resistance of interspecific hybrids Beta vulgaris X B. procumbens to Heterodera schachtii. Ann. Abstr., Soc. of Nematol., October 1974.

Cessation of development of Heterodera schachtii larvae in roots of resistant hybrids may occur at any stage, but most frequently occurs at the 2nd and 3rd stages. Resistance is transferred from trisomics and from newly developed diploid sugarbeets obtained from trisomics to 10-15% of the progeny. The trisomic and diploid plants have about the same level of resistance. When nematodes develop to maturity in roots of resistant plants, typical syncytia develop. Cessation of larval development is attended by early collapse of syncytia, necrosis which frequently extends to the root surface, hyperplastic changes, and by extensive disorganization of host plant tissues in areas adjacent to infection loci.

SUGARBEET RESEARCH

1974 Report

Section B

Crops Research Laboratory, Logan, Utah

Dr. D. L. Doney, Geneticist
Dr. D. L. Mumford, Plant Pathologist
Dr. J. C. Theurer, Geneticist
Dr. R. E. Wyse, Plant Physiologist

Cooperation:

Utah Agricultural Experiment Station

The research was supported in part by funds provided through the Beet Sugar Development Foundation (Projects 17 and 27).

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CONTENTS

SUMMARY OF RESEARCH ACCOMPLISHMENTS
Logan, Utah

J. C. Theurer, D. L. Doney
D. L. Mumford and R. E. Wyse

1974 Variety Tests

The diallel crosses, some of the reciprocal crosses, and the parental inbreds selected for storage and respiration experiments were evaluated for yield, sugar percentage and purity characters. General and specific combining ability was significant for all characters measured. A test of aa vs CMS equivalent hybrids showed no difference in performance. Comparison was made of recently released Logan inbreds L19, L35, L37, and L53 in hybrid combinations involving the same parental lines. Hybrids of high sugar inbreds crossed with the same female lines showed significantly different response.

Genotypic competition between sugarbeet varieties

Experiments involving two competing genotypes have shown that mixtures yield greater than the component pure stands if the component genotypes have high competitive influence. The genotypes tested differed significantly in their competitive influence. Mixtures involving hybrid 8125 significantly out yielded their component pure stand means. There was no genotype times competition interaction. This means that genotypes can be selected for competitive influence using a common competitor rather than in all possible combinations.

Genotype X nitrogen interaction in sugarbeet hybrids

In a test involving 20 genotypes differing in sugar and yield potential grown at 4 nitrogen levels, genotype X nitrogen interactions were obtained for percent sugar, root yield, gross sugar, nitrogen, sodium and impurity index. High yield genotypes tended to respond more to high nitrogen than high sugar genotypes. Some genotypes responded less at high nitrogen levels for nitrogen and sodium accumulation in the roots than other genotypes. There were significant genotype and nitrogen effects of all measured characters.

Preliminary study of the effect of DPX3778 on pollen viability in sugarbeet

Tests were made with a new experimental chemical DPX3778, reported to prevent pollen release from anthers of corn and other crops. Sugarbeets treated with 50, 100, 500,and 1,000 ppm showed little or no effect in fertility. Higher concentrations of the chemical caused burning, necrosis, and abnormal flower development. Preliminary results do not look favorable for the use of DPX3778 as an effective gametocide for sugarbeets.

Studies on new sources of male sterility

New sources of male sterility from Beta maritima were of both

genetic and CMS types. A CMS introduction from USSR was 100% fertile in the greenhouse at Logan. A search was initiated in the world collection of Beta vulgaris for new sources of male sterility.

Physiological genetics of cytoplasmic male sterility

Carefully timed experiments have revealed that meiosis proceeds at about the same speed in CMS as normal anthers until they reach the tetrad stage. The tetrad stage in CMS anthers lasts about twice as long as in normal anthers. By the time the microspores are released from the callose wall in CMS anthers, degeneration has already begun. The pH is lower in CMS anthers and rises and drops later than in normal anthers. Two esterase isozymes appear at early tetrad stage in both CMS and normal anthers. There is a slightly reduced activity in CMS anthers. A systemic insecticide (temik) has been shown to greatly reduce anther esterase activity.

Physiological selection by hypocotyl diameter

Of several seedling characters measured, hypocotyl diameter has been shown to be highly correlated with root yield. This character is conditioned by both additive and non-additive genes and exhibits heterosis in wide crosses. Selection pressure in highly heterozygous populations can increase the hypocotyl diameter of 3 week old seedlings. It appears that this technique can be used as a breeding tool.

Potential use of plant breeding to reduce sucrose loss in storage

Inbreds and hybrids of different genetic background were stored under controlled environments in 1973 and 1974. The respiration rate after 100 days storage was slightly higher in 1974, but the ranking of the varieties was reasonably consistent from year to year.

A diallel cross of eight inbreds including parent lines was stored for 30 days at 5 C. Hybrids generally had lower respiration rates than inbred parents. Respiration rate was found to be conditioned by both additive and non-additive genes. Data indicated that genetic variation exists and effective selection can be made to reduce respiration.

Effect of fluctuations in storage temperatures on sugarbeet storage life

During the past two years studies were made to determine the effect of fluctuating temperatures on sugarbeet respiration in storage. It was apparent from the data that any fluctuation in temperature reduces storage life. The 30-40 F treatment was the least detrimental up to 12 weeks of storage. Beets stored at 30F or below showed a rapid increase in respiration when temperatures were raised above freezing. This indicates that outside air below 30F should not be introduced into a storage pile.

Simulated effect of topping injury on pile temperatures and sucrose losses during the first week of storage in covered piles

High respiration rate during the first few days of storage is a prime

contributor to the "sweat" period and high sucrose losses during the early part of the storage period. Losses during the first two weeks of storage may account for 30-50% of the total loss during a 100-day storage period.

Losses in storage can be minimized by storing cool beets and the use of refrigeration.

A preliminary model is suggested as an excellent aid in developing storage management practices.

Use of fungicides to reduce deterioration of sugarbeet roots in storage

Fungicides were evaluated in agar medium and on sugarbeet roots to determine their ability to reduce fungus growth and thereby reduce deterioration in storage. Benomyl caused the greatest inhibition of Botrytis and Penicillium on agar medium. A spray application of benomyl at 1,000 ppm completely controlled these fungi on stored roots even when the roots were injured and inoculated.

ABSTRACTS OF PAPERS APPROVED FOR PUBLICATION

DONEY, D. L., J. C. THEURER, and R. E. WYSE. The relationship between mitochondrial complementation and root yield heterosis in sugarbeet. Euphytica 24:2. 1975.

Oxidative phosphorylation of sugarbeet root mitochondria isolated from 11 hybrids and their parental inbreds, and of mixtures of mitochondria from the parental inbreds, were measured at four different sampling stages, (Aug 1-7, Sept 1-7 roots stored at 5C, and regrowth of stored roots). Mitochondrial complementation (the increased efficiency or ADP:O ratio of mixtures of inbred mitochondria) was calculated for each hybrid at each stage. When beets were growing rapidly (Aug 1-7) it was small but at the other stages it was absent. Only at the Aug 1-7 sampling stage was there a significant correlation (0.75) between mitochondrial complementation and root weight heterosis.

The small complementation effects made it difficult to detect differences in complementation, and thus difficult to predict root yield heterosis. Thus, this technique is not recommended as a tool in sugarbeet-breeding.

DONEY, D. L., R. E. WYSE, and J. C. THEURER. Mitochondrial efficiency and growth rate in sugarbeet. Crop Sci. 15:1. 1975.

Growth rate and root mitochondrial oxidative phosphorylation measurements were made on sugarbeet (Beta vulgaris L.) to examine the relationships between these important factors. Measurements were made on eight hybrids and their inbred parents on four dates in 1971 and on two hybrids and their inbred parents at bi-weekly intervals in 1972. Hybrids had faster growth rates (root weight and total weight) and more efficient mitochondria (larger ADP:O ratios) than their inbred parents. Root mitochondrial measurements (R:C ratio, ADP:O ratio and state-3 oxidation rate) made in 1971 were largest when plants were growing most rapidly (Aug 1-7) and smallest in stored roots (Nov 15). In 1972, mitochondrial efficiency (ADP:O ratio) measurements departed from growth-rate measurements in the early and latter part of the growing season but were highly correlated (0.87) with root fresh weight and total dry weight from early July to mid-October. A close relationship was obtained between root mitochondrial efficiency (ADP:O ratio) and growth rate throughout the major part of the growing season.

MUMFORD, DAVID L. Procedure for inducing curly top epidemics in field plots. J. Am. Soc. Sugarbeet Technol. 17: 1975.

A procedure was described for artifically producing curly top disease epidemics in sugarbeet field plots. Late planting combined with uniform inoculation by releasing viruliferous leafhoppers has produced very favorable disease levels during two consecutive years. This has made it possible to evaluate breeding lines for disease resistance during years when natural epidemics did not occur.

VARIETY TESTS, LOGAN AND FARMINGTON, UTAH 1974

SOIL TYPES: North Farm: Silty loam. Farmington Farm: Sandy loam.

PREVIOUS CROPS: North Farm: 1972 fallowed, 1973 cereal grains
Farmington Farm: 1972 Fallowed
1973 Beans and Tomatoes

FERTILIZER: North Farm: 640 pounds per acre of 16-20-0.
Farmington Farm: " "

PLANTING DATES: North Farm: May 14, 1974.
Farmington Farm: April 22, 1974
(tests at both farms were planted in 2-row plots 38 feet long)

THINNING DATES: North Farm: June 17-21, 22, 1974
Farmington Farm: May 25-27, 1974

IRRIGATIONS: North Farm: sprinkled after planting, after thinning, and on a weekly schedule until 2 weeks before harvest.

Farmington Farm: furrow irrigated as needed to keep the field on the damp side throughout the season (approximately weekly intervals) until 2 weeks before harvest.

HARVEST DATES AND PROCEDURES: North Farm: October 7-12, 1974
Farmington Farm: October 22-25, 1974.

Tops were removed by beating twice with a rotobeater, then topped and harvested with a two-row harvester. Beets in plots were counted into the weighing basket on the harvester. A 10-beet sample was taken at random from the harvester table from each row of the 2-row plots for sugar analysis, and all beets in the plot were weighed to determine root yield.

TEST 1

Wide differences were noted in the storageability of F_1 hybrids evaluated in 1973. The primary purpose of this test was to evaluate a diallel cross between eight inbreds for storageability. Seed was available for 20 reciprocal crosses of the hybrids included in the diallel. These were included in Test 1 along with sixteen of the inbred parents and four commercial check varieties. Thus there were 81 entries planted in two-row plots, 40' long, in six replicates of a split-plot experiment. In the randomization a further restriction was imposed among the hybrids in that the reciprocal hybrids were planted in adjacent plots.

Table 1-1 shows data of the complete test. Hybrids with L53 were highest in gross sugar demonstrating the good general combining ability of this inbred for yield. L53CMS was also highest in yield among the inbred lines. The lower yield of L53 and E1 pollinator inbreds was due to poor stand as reflected in the beet count for these inbreds. L38, F_4, A4, and L35 also had poor stands. L9 was significantly higher than all other inbreds for tonnage with the exception of L53CMS. L19 was significantly superior to all inbreds except L20 in sugar percentage.

A comparison of the performance of reciprocal crosses is given in Table 1-2. In general there was little difference between reciprocals. Those that showed significance in yield usually had significant differences in beet count. L53 X FC504 and L19 X L33 reciprocals were significantly different for yield. L29 X A1-1, L53 X A1-10, L53 X EL-1 and L53 X L9 reciprocals were appreciably different for one or more quality factors. L53 X A1-10 reciprocals were different in sugar percentage.

Diallel analysis (Griffing, B., Aust. J. Biol. Sci 9:463-493), for yield, sugar percentage, and quality factors can be observed in Tables 1-3 to 1-9. The means for both general and specific combining ability were significant for every character measured. L53 and EL inbreds showed the greatest general combining ability for yield. A4 and L53 were high for sugar percentage. L33 and F4 inbreds usually showed general combining ability for low yield and high impurity factors.

TEST 2

A 1967 variety indicated that there were significant differences in sugar percent and impurity factors between equivalent CMS and aa male-sterile hybrids. Residual seed was available for making four aa vs CMS hybrid comparisons. This seed was planted in three replications of two-row plots at Farmington. A two-row buffer strip of the commercial variety TASCO AH10 was planted between each plot. The stand of L29 aa X L19 and L29 aa X E2 was so poor that a comparison between these aa vs CMS hybrids was meaningless. The performance of the other two comparisons is given in Table 2-1. Significant differences in percent sugar, root weight, sodium, potassium, and impurity index were observed for varieties. There was no difference between aa and CMS hybrids derived from equivalent parental lines.

TEST 3

This variety test was established to evaluate recently released "L" lines in hybrid combination with other diverse inbreds. The 28 entries consisted of four pollinators each crossed to the same seven females. Each entry was planted in six replicates of two-row plots, 40 ft long at the Logan Greenville farm.

The relative yield, sugar percentage, and impurity factors for these hybrids is shown in table 3-1. Hybrid 326, a cross of high yield inbreds L53 and L37, gave the greatest gross sugar, mainly due to root weight. L53 X L19 and R2 X L19 hybrids had the highest sugar percentage (16.48%). The hybrid of F. C. 504 X F.C. 506 (code 316) had the lowest yield and the lowest sugar percent in the test.

Statistical analysis was made for males and females for each character studied; however, only three tables of data are included in this report. L53 was significantly ($F=5.4^{**}$) higher in gross sugar on the average than the other inbreds used as female parents. Likewise, L37 showed significantly ($F=27.8^{**}$) the greatest general combining ability for gross sugar for male parents. L19 averaged higher yield than L35 or F6. Similar observations can be noted for these inbreds for root weight (Table 3-2). Male X female interactions indicated little evidence for specific combining ability for root yield.

L19, as expected, showed superior general combining ability for sugar percentage (Table 3-3). All other comparisons among males or females and the female X male interactions were non-significant for this character.

Amino N, sodium and potassium content, as well as the impurity index analysis, showed highly significant differences for both general and specific combining ability. Only the impurity index values are given in this report (Table 3-4). The EL (EL 31) inbred had a significantly higher impurity index value than other female parents and L37 had the greatest combining ability for poor quality. Specific combining ability was noted for A5 X L37, EL X L37, L29 X L37, and L53 X L37 for high impurity index values. F4 X L35, A4 X L19, and A5 X L19 had superior specific combining ability for low impurity indexes.

Inbreds A4 and A5 as female parents and L35 and L19 as male parents generally showed specific combining ability for low N, Na, and K.

These data provide a useful summary of the relative merits of four of the recently released inbreds from the Logan station, L19, L35, L37, L53.

TEST 4

Five pollinator inbreds, observed in past years to contribute to good sugar percentage, were crossed with the same set of CMS females

for yield and sugar percent comparisons. Seed of one cross, L29 CMS X A7135 was insufficient to be included in the test. Seven commercial varieties and five L-inbreds were also included as checks. The 36 entries were seeded in six replicates of 2-row plots, 36 feet long, in a split-plot design (hybrids vs inbreds).

The relative performance of the entries is given in table 4-1. The four hybrids with A7135 as a parent were highest in gross sugar yield which was mainly due to tonnage. The highest yielding hybrid, however, was not significantly superior to three checks, TASCO AH 11, UI hybrid B, and UI hybrid D. L53CMS X L19 and (L29 X L20) X L19 had over 18% sugar. The poor yield of seven hybrids (codes 409, 419, 403, 414, 405, 401, and 404) was primarily due to poor stand as evidenced by the beet count for these varieties at harvest.

Inbreds L20, L37, and L53 are yield types,whereas L19 and L8 are sugar types. This was again manifest in this year's data (Table 4-1) for L20, L19, and L37. L53 yield was poor and L8 sugar was lower than expected, primarily because of the poor stand of beets in these plots. At the onset of the experiment it was thought that we would be able to relate L8 and L19 parental response with their hybrids. However, the low beet count for L8 precludes the validity of these comparisons.

The combining ability for male and female parents for each character studied are shown in tables 4-2 to 4-8. A7135 was significantly higher than all other male parents indicating excellent combining ability for root yield. L-19 and L8 were equal for sugar percentage and exhibited significant general combining ability for sugar percentage. The data in Table 4-4 indicate that most of the variation for sugar percentage for both L8 & L19 is additive. High sugar lines L8 and L19 showed good combining ability for low ppm Na, but not for other impurity factors. (L29 X L21) was the female parent that significantly contributed more to sugar percentage and impurity factors. Only sugar percentage and gross sugar showed a significant male X female interaction.

The comparative performance of L8 vs 0461 is interesting since L8 is a S_6 sugar selection of 0461. In this test 0461 had significantly greater yield and significantly less combining ability for sugar.

Table 1-1. Yield sugar percentage and quality factors for hybrids and inbreds for root storage. Logan, Utah 1974

Code	Description	Acre Yield		Percent Sugar	PPM				Beet Count
		Gross Sugar(LBS)	Tons Beets		Index	N	Na	K	
130	F4 CMS X L53	7631	24.57	15.52	756	640	385	1579	77
103	L29 CMS X L53	7543	25.52	14.77	736	646	342	1277	84
126	A5 CMS X L53	7203	22.89	15.73	636	560	268	1387	80
127	L53 CMS X E1	7188	23.23	15.46	713	674	276	1312	78
156	L9 CMS X L53	7093	23.51	15.12	700	574	340	1417	78
128	E1 CMS X L53	7056	22.22	15.83	761	757	372	1263	69
104	L53 CMS X L29	7054	24.29	14.51	750	657	292	1307	78
132	F5 CMS X L53	6914	22.55	15.34	662	626	288	1144	72
157	HH22	6842	23.23	14.73	688	545	211	1577	87
150	A5 CMS X E1	6815	21.99	15.48	598	474	275	1371	86
113	L29 CMS X F4	6808	23.11	14.71	664	509	386	1345	85
111	L29 CMS X E1	6788	22.02	15.40	662	595	279	1300	72
160	UI Hybrid D	6768	22.27	15.16	631	593	240	1116	79
159	TASCO AH 11	6766	22.44	15.03	680	545	255	1540	82
122	A1 CMS X L53	6744	22.22	15.18	754	745	287	1170	83
112	E1 CMS X L29	6722	22.00	15.26	619	539	289	1209	71
107	L29 CMS X A4	6707	21.27	15.70	572	528	188	1198	81
121	L53 CMS X A1	6668	22.64	14.74	812	755	274	1361	79
155	L53 CMS X L9	6664	21.94	15.14	668	558	262	1409	76
129	L53 CMS X F4	6631	22.27	14.88	759	598	374	1587	74
108	A4 CMS X L29	6606	21.24	15.48	537	443	186	1292	74
131	L53 CMS X F5	6543	21.83	14.96	657	549	346	1238	79
138	F4 CMS X F5	6516	21.24	15.31	639	499	399	1352	74
148	A4 CMS X A5	6432	20.40	15.77	560	449	209	1433	86
149	A4 CMS X E1	6400	20.32	15.73	651	587	307	1303	85
139	F4 CMS X E1	6346	20.04	15.81	681	592	374	1403	66

Table 1-1(continued). Yield sugar percentage and quality factors for hybrids and inbreds for root storage. Logan, Utah 1974

Code	Description	Acre Yield		Percent	PPM				Beet
		Gross Sugar(Lbs)	Tons Beets	Sugar	Index	N	Na	K	Count
153	L33 CMS X L9	6343	21.44	14.79	656	523	320	1335	71
125	L53 CMS X A5	6243	20.04	15.58	627	502	321	1445	65
114	F4 CMS X L29	6234	21.16	14.74	677	550	333	1317	81
110	A5 CMS X L29	6221	21.16	14.68	629	504	313	1246	90
116	A1 CMS X L33	6201	21.16	14.62	739	652	299	1284	81
152	L9 CMS X L29	6193	21.24	14.58	705	596	330	1259	70
106	A1 CMS X L29	6183	20.76	14.86	741	702	231	1264	81
142	A5 CMS X L33	6180	20.65	14.97	645	541	322	1222	85
147	E1 CMS X A1	6138	20.71	14.68	831	787	331	1204	77
146	A5 CMS X A1	6102	20.46	14.92	670	579	289	1272	83
136	F4 CMS X A4	6079	19.31	15.70	537	427	263	1285	73
118	A4 CMS X L33	6041	20.09	15.02	817	795	282	1330	84
144	F4 CMS X L33	6012	19.45	15.46	620	529	328	1249	83
137	A5 CMS X F4	5971	19.98	14.93	646	482	395	1372	78
140	F4 CMS X E1	5923	19.48	15.16	682	557	350	1401	72
141	L53 CMS X L33	5910	20.34	14.58	729	661	344	1118	66
154	L9 CMS X L33	5812	19.98	14.53	685	564	342	1219	58
158	TASCO AH4	5800	19.56	14.76	620	482	312	1281	78
102	L33 CMS X L29	5783	20.54	14.10	706	578	356	1165	71
134	F4 CMS X A1	5772	20.26	14.20	746	592	387	1314	85
135	A4 CMS X F4	5664	18.08	15.66	543	424	256	1342	77
145	A4 CMS X A1	5571	18.47	15.08	642	559	235	1300	74
123	L53 CMS X A4	5564	19.34	14.40	645	493	326	1268	65
105	L29 CMS X A1	5546	18.95	14.62	703	653	240	1156	76
124	A4 CMS X L53	5531	17.24	16.03	754	816	207	1277	72
151	L29 CMS X L9	5353	17.91	14.98	663	566	337	1209	68

Table 1-1 (continued). Yield sugar percentage and quality factors for hybrids and inbreds for root storage. Logan, Utah 1974.

Code	Description	Acre Yield		Percent Sugar	PPM				Beet Count
		Gross Sugar(Lbs)	Tons Beets		Index	N	Na	K	
115	L33 CMS X A1	5280	17.99	14.57	742	652	277	1283	63
133	A1 CMS X F4	5233	17.69	14.83	746	617	392	1388	64
109	L29 CMS X A5	5132	16.96	15.10	673	544	318	1438	57
101	L29 CMS X L33	5006	17.21	14.55	669	570	337	1138	71
119	L33 CMS X F5	4381	15.47	14.12	661	447	382	1421	37
117	L33 CMS X A4	3981	13.18	15.08	712	607	333	1393	40
120	F5 CMS X L33	3893	13.54	14.24	670	501	394	1234	30
143	E1 CMS X L33	3769	13.15	14.12	925	787	440	1424	34
	Inbreds								
166	L53 CMS	6436	21.44	14.99	683	610	308	1218	84
176	L9 CMS	6296	23.67	13.34	771	583	304	1529	69
180	L19♂	5619	17.18	16.35	552	542	242	1103	89
173	E1 CMS	5256	17.69	14.86	765	687	308	1358	52
177	L20♂	4830	15.33	15.70	522	440	134	1330	63
168	A1 CMS	4762	16.99	13.98	757	665	309	1130	78
161	L29	4744	17.96	13.18	775	541	398	1347	74
171	A5♂	4626	15.31	15.03	643	497	317	1404	82
178	L37♂	4583	15.89	14.34	1056	1031	257	1577	73
162	L29 CMS	4406	15.78	13.97	629	474	310	1178	56
167	A1	4091	14.92	13.65	856	774	270	1184	67
170	A4 CMS	4055	13.54	14.97	608	516	158	1347	65
181	L35♂	3357	11.70	14.48	805	696	236	1541	49
175	F4 CMS	3332	12.17	13.70	906	655	485	1660	60
169	A4♂	3037	10.30	14.58	647	539	192	1333	53
174	F4♂	2977	10.66	14.06	926	712	379	1801	53

Table 1-1 (continued). Yield sugar percentage and quality factors for hybrids and inbreds for root storage. Logan, Utah 1974.

Code	Description	Acre Yield		Percent	PPM				Beet
		Gross Sugar (lbs)	Tons Beets	Sugar	Index	N	Na	K	Count
172	E1♂	2798	9.68	14.34	746	652	292	1219	42
165	L53♂	2554	8.42	15.14	744	745	250	1170	51
179	L38	1857	6.80	13.56	1475	1606	275	1140	49
Mean of all Entries		5672	19.00	14.87	708	609	305	1320	70
Standard Error		806	2.44	0.68	103	108	68	203	12
LSD (5% Point)		921	2.7	0.76	118	124	78	234	13
C. V. Percent		14.2	12.8	4.5	14.5	17.8	22.2	15.4	16.5
Calculated F		14.6**	15.94**	5.19**	9.23**	12.43**	5.45**	2.66**	9.67**

Table 1-2. Yield Sugar Percentage, and Quality Factors for Reciprocal F_1 Hybrids, Logan, Utah 1974.

Code	Description	Acre Yield: Gross Sugar (lbs)	Acre Yield: Tons Beets	Percent Sugar	PPM: N	PPM: Na	PPM: K	PPM: Index	Beet Count
101	129CMS X 133	5006	17.2	14.6	570	337	1138	669	71
102	133CMS X 129	5783	20.5	14.1	578	356	1165	706	71
103	129CMS X L53	7543	25.5	14.8	646	342	1277	736	84
104	L53CMS X 129	7054	24.3	14.5	657	292	1307	750	78
105	129CMS X AI-1	5546	18.9	14.6	653	240	1156	703	76
106	AI-1CMS X 129	6183	20.8	14.9	702	231	1264	741	80
107	129CMS X AI-10	6707	21.3	15.7	528	188	1198	572	80
108	AI-10CMS X 129	6606	21.2	15.5	443	186	1292	537	74
109	129CMS X AI-12	5132	17.0	15.1	544	318	1438	673	57
110	AI-12CMS X 129	6220	21.1	14.7	504	313	1246	629	90
111	129CMS X EL31	6788	22.0	15.4	595	279	1300	662	72
112	EL31CMS X 129	6722	22.0	15.3	539	289	1209	619	71
113	129CMS X FC504	6808	23.1	14.7	509	386	1345	664	85
114	FC504CMS X 129	6234	21.2	14.7	550	333	1317	677	81
115	133CMS X AI-1	5280	18.0	14.6	652	277	1283	742	63
116	AI-1CMS X 133	6201	21.2	14.6	652	299	1284	739	81
117	133CMS X AI-10	3981	13.2	15.1	607	333	1393	712	40
118	AI-10CMS X 133	6041	20.1	15.0	795	282	1330	817	84

Table 1-2 (Continued). Yield Sugar Percentage and Quality Factors for Reciprocal F_1 Hybrids, Logan, Utah 1974.

Code	Description	Acre Yield		Percent	PPM				Beet
		Gross Sugar (lbs)	Tons Beets	Sugar	N	Na	K	Index	Count
119	133CMS X FC601	4381	15.4	14.1	447	382	1421	661	37
120	FC601CMS X 133	3893	13.5	14.2	501	394	1234	670	30
121	L53CMS X AI-1	6668	22.6	14.7	755	274	1361	812	79
122	AI-1CMS X L53	6744	22.2	15.2	745	287	1170	754	83
123	L53CMS X AI-10	5564	19.3	14.4	493	326	1268	645	65
124	AI-10CMS X L53	5531	17.2	16.0	816	207	1277	754	72
125	L53CMS X AI-12	6243	20.0	15.6	502	321	1445	627	65
126	AI-12CMS X L53	7203	22.9	15.7	560	268	1387	636	80
127	L53CMS X EL 31	7188	23.2	15.5	674	276	1312	713	78
128	EL31CMS X L53	7056	22.2	15.8	757	372	1263	761	69
129	L53CMS X FC 504	6631	22.3	14.9	598	374	1587	759	74
130	FC504CMS X L53	7631	24.6	15.5	640	385	1579	756	77
131	L53CMS X FC601	6543	21.8	15.0	549	346	1238	657	79
132	FC601CMS X L53	6914	22.5	15.3	626	288	1144	662	72
133	AI-1CMS X FC504	5233	17.7	14.8	617	392	1388	746	64
134	FC504CMS X AI-1	5772	20.3	14.2	592	387	1314	746	85
135	AI-10CMS X FC504	5664	18.1	15.7	424	256	1342	543	77
136	FC504CMS X AI-10	6079	19.3	15.7	427	263	1285	537	73

Table 1-2(Continued). Yield Sugar Percentage and Quality Factors for Reciprocal F_1 Hybrids, Logan, Utah, 1974.

Code	Description	Acre Yield		Percent	PPM				Beet
		Gross Sugar (Lbs)	Tons Beets	Sugar	N	Na	K	Index	Count
137	AI-12CMS X FC504	5971	20.0	14.9	482	395	1372	646	78
138	FC504CMS X AI-12	6516	21.3	15.3	499	399	1353	639	74
139	EL31CMS X FC504	6346	20.0	15.8	592	374	1403	681	66
140	FC504CMS X EL31	5923	19.5	15.2	557	350	1401	682	72
151	129CMS X L9	5353	17.9	15.0	566	337	1209	663	68
152	L9CMS X 129	6193	21.2	14.6	596	330	1259	705	70
153	133CMS X L9	6343	21.4	14.8	523	320	1335	656	71
154	L9CMS X 133	5812	20.0	14.5	564	342	1219	685	58
155	L53CMS X L9	6665	21.9	15.1	558	262	1409	668	76
156	L9CMS X L53	7093	23.5	15.1	574	340	1417	700	81
	Inbreds								
161	129CMS	6269	20.9	15.0	582	300	1233	667	77
162	129	6400	21.6	14.8	580	293	1259	676	75
	133CMS	5082	17.9	14.1	513	369	1293	684	54
163	133	4450	15.4	14.4	536	366	1186	670	51
166	L53CMS	6570	21.9	15.0	598	309	1366	704	74
165	L53	6964	22.6	15.4	670	311	1314	720	77
168	AI-1CMS	6090	20.5	14.9	679	302	1277	745	77
167	AI-1	5816	20.0	14.5	663	295	1279	751	76

Table 1-2 (Continued). Yield Sugar Percentage and Quality Factors for Reciprocal F_1 Hybrids, Logan, Utah 1974

Code	Description	Acre Yield: Gross Sugar (Lbs)	Acre Yield: Tons Beets	Percent Sugar	PPM: N	PPM: Na	PPM: K	PPM: Index	Beet Count
170	AI-10CMS	5934	18.8	15.6	619	233	1310	663	77
169	AI-10	6117	20.0	15.2	514	277	1286	617	65
	AI-12CMS	6465	21.3	15.1	515	325	1335	637	83
171	AI-12	5964	19.4	15.3	515	346	1412	646	65
173	EL31CMS	6708	21.4	15.6	629	345	1292	687	69
172	EL31	6633	21.6	15.4	609	302	1338	685	74
175	FC504CMS	6359	21.0	15.1	544	353	1375	673	77
174	FC504	6109	20.2	15.1	537	363	1406	673	74
	FC601CMS	5404	18.0	14.8	564	341	1189	666	51
	FC601	5462	18.6	14.6	498	364	1329	659	58
176	L9CMS	6366	21.6	14.7	578	337	1298	697	70
	L9	6120	20.4	15.0	549	306	1318	662	72
Mean of All Entries		6150	20.4	15.0	586	314	1311	685	
Standard		812	2.37	0.6	94	66	193	91	
LSD 5% Point		919	2.6	0.7	107	75	218	103	
C.V. Percent		13.2	11.6	4.2	16.1	20.9	14.7	13.3	
Calculated F		6.48**	7.38**	3.6**	5.86**	4.32**	1.633**	2.99**	

Table 1-3. Diallel analysis for gross sugar.

	CMS Female								
Male	L29	L33	L53	A1	A4	A5	E1	F4	Total Mean
L29	4675	5783	7054	6183	6606	6221	6722	6234	6017
L33		3380	5907	6201	6041	6180	6441	6013	5481
L53			6436	6744	5531	7203	7056	7631	6667
A1				4762	5571	6102	6138	5772	5804
A4					4055	6432	6400	6079	5641
A5						4626	6815	6516	6080
E1							5256	5923	6223
F4								3155	5609

GCA F ratio = 13.57**
SCA F ratio = 10.23**
LSD 5% point for line (total) means = 278
LSD 5% point for individual entry means = 1021

Table 1-4. Diallel analysis for beet weight;

	CMS Female								
Male	L29	L33	L53	A1	A4	A5	E1	F4	Total Mean
L29	16.9	20.5	24.3	20.8	21.2	21.2	22.0	21.2	20.5
L33		13.0	20.3	21.2	20.1	20.7	22.8	19.4	19.0
L53			21.4	22.2	17.2	22.9	22.2	24.6	21.9
A1				17.0	18.5	20.5	20.7	20.3	19.8
A4					13.5	20.4	20.3	19.3	18.2
A5						15.3	22.0	21.2	19.9
E1							17.7	19.5	20.6
F4								12.2	18.9

GCA F ratio = 14.04**
SCA F ratio = 10.24**
LSD 5% point for line (Total) means = .81
LSD 5% point for individual entry means = 3.4

Table 1-5. Diallel analysis for sugar percentage.

	CMS Female								
Male	L29	L33	L53	A1	A4	A5	E1	F4	Total Mean
L29	13.5	14.1	14.5	14.9	15.5	14.7	15.3	14.7	14.5
L33		13.0	14.6	14.6	15.0	15.0	14.1	15.5	14.3
L53			15.0	15.2	16.0	15.7	15.8	15.5	15.3
A1				14.0	15.1	14.9	14.7	14.2	14.6
A4					15.0	15.8	15.7	15.7	15.4
A5						15.0	15.5	15.3	15.2
E1							14.9	15.2	15.1
F4								13.9	14.9

GCA F ratio = 20.5**
SCA F ratio = 4.27**
LSD 5% point for line (Total) means = .22
LSD 5% point individual entry means = .90

Table 1-6. Diallel analysis for PPM Nitrogen.

	CMS Female								
Male	L29	L33	L53	A1	A4	A5	E1	F4	Total Mean
L29	506	578	657	702	443	504	539	550	554
L33		670	661	652	795	541	787	529	654
L53			610	745	816	560	757	640	673
A1				665	559	579	787	592	661
A4					516	449	587	427	568
A5						497	474	499	511
E1							687	557	651
F4								683	573

GCA F ratio = 19.7**
SCA F ratio = 4.53**
LSD 5% point for line (Total) means = 36
LSD 5% point for individual entry means = 184

Table 1-7. Diallel analysis for PPM Sodium.

	CMS Female								
Male	L29	L33	L53	A1	A4	A5	E1	F4	Total Mean
L29	354	356	292	231	186	313	289	333	301
L33		400	344	299	282	322	440	328	352
L53			308	287	207	268	371	385	307
A1				309	235	289	331	387	297
A4					175	209	307	263	226
A5						317	275	399	301
E1							308	350	331
F4								432	368

GCA F ratio = 23.82**
SCA F ratio = 2.37**
LSD 5% point for line (Total) means = 23
LSD 5% point for individual entry means = 78

Table 1-8. Diallel analysis for PPM Potassium.

	CMS Female								
Male	L29	L33	L53	A1	A4	A5	E1	F4	Total Mean
L29	1262	1165	1307	1264	1292	1246	1209	1317	1258
L33		1750	1118	1284	1330	1222	1424	1249	1366
L53			1218	1170	1277	1387	1263	1579	1282
A1				1130	1300	1272	1204	1314	1230
A4					1347	1433	1303	1285	1324
A5						1404	1371	1353	1344
E1							1358	1401	1321
F4								1730	1440

GCA F ratio = 6.07**
SCA F ratio = 2.73**
LSD 5% point for line (Total) means = 69
LSD 5% point for individual entry means = 292

Table 1-9. Diallel analysis for impurity index.

	CMS Female								
Male	L29	L33	L53	A1	A4	A5	E1	F4	Total Mean
L29	702	706	750	741	537	629	619	677	674
L33		890	729	739	817	645	925	620	773
L53			683	754	754	636	761	756	723
A1				757	642	670	831	746	737
A4					608	560	651	537	635
A5						643	598	639	629
E1							765	682	733
F4								916	721

GCA F ratio = 16.1**
SCA F ratio = 4.6**
LSD 5% point for line (Total) means = 34
LSD 5% point for individual entry means = 172

Table 2-1. Yield, sugar percentage, and quality factors for aa vs CMS hybrids, at Farmington, Utah 1974.

Code	Description	Acre Yield Gross Sugar	Acre Yield Tons Beets	Percent Sugar	PPM Index	PPM N	PPM Na	PPM K	Beet Count
205	L29CMS X 00.5	9971	31.0	16.1	584	390	407	1636	65
206	L29 aa X 00.5	8832	28.1	15.8	590	335	482	1689	55
207	L28CMS X L19	9140	24.3	18.9	410	315	165	1596	37
208	L28 aa X L19	8507	22.4	19.0	395	378	119	1319	59
Mean of all Varieties		9112	26.43	17.43	495	355	293	1560	54.17
Standard Error		1018	3.26	.58	54.96	32.01	77.47	101.61	6.80
LSD (5% point)		2033	6.5	1.16	110	64	155	203	13.5
C.V. %		11.16	12.3	3.34	11.11	9.03	26.4	6.51	12.55
CMS vs aa		NS	NS	NS	NS	NS	NS	NS	NS

Table 3-1. Yield, sugar percentage and quality factors for four "L" hybrids - Logan, Utah 1974.

Code	Description	Acre Yield		Percent	PPM				Beet
		Gross Sugar (Lbs)	Tons Beets	Sugar	Index	N	Na	K	Count
326	L53 X L-37	7817	24.46	15.96	808	813	167	1659	94
327	L53 X L-19	7756	23.62	16.48	585	551	256	1287	79
318	R2 X L-37	7491	23.50	15.92	715	660	186	1621	90
310	E1 X L-37	7194	23.00	15.63	905	890	205	1796	76
314	F4 X L-37	7037	22.47	15.63	691	577	274	1631	88
323	29 X L-19	6969	22.22	15.65	554	453	227	1311	95
306	A5 X L-37	6831	22.19	15.41	762	689	199	1649	92
319	R2 X L-19	6724	20.32	16.48	568	499	284	1343	90
322	L29 X L-37	6649	21.66	15.39	771	722	213	1537	81
302	A4 X L-37	6410	20.60	15.56	716	667	160	1564	75
325	L53 X L-35	6287	19.76	15.93	569	496	221	1306	75
328	L53 X F6	6244	20.04	15.59	659	542	255	1580	68
324	L29 X F6	6200	20.15	15.35	579	466	253	1335	79
303	A4 X L-19	6150	18.64	16.36	496	431	196	1233	79
315	F4 X L-19	6102	19.87	15.34	663	467	385	1667	81
307	A5 X L-19	6100	18.52	16.31	475	352	228	1351	83
305	A5 X L-35	5516	18.02	15.32	601	483	195	1479	80
312	E1 X F6	5508	17.55	15.55	691	625	249	1398	78
311	E1 X L-19	5378	17.04	15.74	671	559	328	1535	55
308	A5 X F6	5330	17.24	15.35	556	415	265	1360	79
301	A4 X L-35	5265	17.07	15.21	576	463	153	1427	64
313	F4 X L-35	5252	16.62	15.83	489	381	193	1294	77
320	R2 X F6	5240	16.93	15.38	635	542	260	1376	74
317	R2 X L-35	5211	17.24	15.08	520	421	214	1151	78
304	A4 X F6	5194	16.90	15.33	516	403	218	1252	80
321	L29 X L-35	5083	16.26	15.50	574	494	217	1282	66

Table 3-1. (continued) Yield, sugar percentage and quality factors for four "L" hybrids - Logan, Utah 1974.

Code	Description	Acre Yield: Gross Sugar (Lbs)	Acre Yield: Tons Beets	Percent Sugar	PPM: Index	PPM: N	PPM: Na	PPM: K	Beet Count
309	E1 X L-35	4759	15.73	15.04	567	475	209	1209	58
316	F4 X F6	4439	14.86	14.89	696	514	355	1559	67
Mean of all entries		6076	19.37	15.61	629	538	235	1436	78
Standard error		1015	2.98	0.83	92	96	56	208	10
LSD (5% point)		1160	3.4	0.95	105	109	63	238	12
C. V. percent		16.7	15.4	5.3	14.5	17.8	23.6	14.5	18.5
Calculated F		4.95**	4.95**	1.52**	7.82**	10.95**	5.85**	3.92**	5.2**

Table 3-2. Mean root weight of male and female parents in "L" inbred variety test. Logan, Utah 1974

Females	Males				
	L35	L37	L19	F6	Mean
A4	17.07	20.60	18.64	16.90	18.30
A5	18.02	22.19	18.52	17.24	18.99
E1	15.78	23.00	17.04	17.55	18.34
F4	16.62	22.47	19.87	14.86	18.45
R2	17.24	23.51	20.32	16.93	19.50
L29	16.26	21.66	22.22	20.15	20.07
L53	19.76	24.46	23.62	20.04	21.97
Mean	17.25	22.55	20.03	17.67	19.38

Females = 4.7** F ratio
Males = 28.39**
F X M = 1.13 ns

LSD.05 between Hybrids = 3.4
between Females = 1.7
between Males = 1.3

Table 3-3. Mean sugar percentage of male and female parents in "L" inbred variety test, Logan, Utah 1974.

Females	Males				
	L35	L37	L19	F6	Mean
A4	15.21	15.56	16.36	15.33	15.61
A5	15.32	15.41	16.31	15.35	15.60
E1	15.04	15.63	15.74	15.55	15.49
F4	15.83	15.63	15.34	14.89	15.42
R2	15.08	15.92	16.48	15.38	15.71
L29	15.50	15.39	15.65	15.35	15.47
L53	15.93	15.96	16.48	15.59	15.99
Mean	15.41	15.64	16.05	15.35	15.61

Females = 1.288 ns F ratio
Males = 6.089**

LSD.05 = between Hybrids = 0.95
between Females = 0.48

Table 3-4. Mean impurity index of male and female parents in "L" inbred variety test, Logan, Utah 1974.

Females	Males				
	L35	L37	L19	F6	Mean
A4	576	716	496	516	576
A5	601	762	475	556	599
E1	567	905	671	691	709
F4	439	691	663	696	635
R2	520	715	568	635	610
L29	574	771	554	579	620
L53	569	808	585	659	655
Mean	557	767	573	619	629

Females = 5.36** F ratio
Males = 45.78**
F X M = 2.31**

LSD.05 between Hybrids = 105
between Females = 52
between Males = 40

Table 4-1. Yield, sugar percentage and impurity factors for high sugar lines Farmington, Utah 1974

Code	Description Hybrids	Acre Yield Gross Sugar	Acre Yield Tons Beets	Percent Sugar	PPM Index	PPM N	PPM Na	PPM K	Beet Count
413	(L12 X C1) CMS X A7135	11,116	33.24	16.73	521	398	355	1391	78
408	L53 CMS X A7135	10,666	32.88	16.22	623	470	437	1538	74
418	(L29 X L20) CMS X A7135	10,636	32.04	16.60	561	431	481	1311	78
423	(L29 X L21) CMS X A7135	10,548	32.24	16.39	544	399	438	1340	78
426	Tasco All 11	10,360	31.79	16.27	533	329	375	1623	82
430	UI Hybrid B	10,329	30.89	16.74	609	528	407	1384	76
429	UI Hybrid D	10,316	31.45	16.45	494	336	425	1280	79
427	Tasco All 10	9,929	30.61	16.25	510	335	307	1538	76
402	L29 CMS X L19	9,865	27.93	17.68	532	426	342	1564	85
431	HH 22	9,465	31.06	15.28	600	375	419	1569	75
411	(L12 X C1) CMS X L19	9,432	26.75	17.63	525	415	280	1642	69
406	L53 CMS X L19	9,408	25.38	18.20	568	525	303	1606	74
428	Tasco All1A	9,188	27.70	16.55	467	314	316	1394	79
412	(L12 X C1) CMS X 0461	9,188	29.16	15.75	523	304	566	1274	76
421	(L29 X L21) CMS X L19	9,051	25.41	17.78	483	371	325	1467	76
416	(L29 X L20) CMS X L19	8,976	24.82	18.07	559	499	320	1583	68
425	Tasco All 4	8,925	27.26	16.38	504	337	370	1417	76
417	(L29 X L20) CMS X 0461	8,811	27.68	15.94	546	361	457	1374	71
422	(L29 X L21) CMS X 0461	8,777	27.14	16.13	519	327	464	1381	63
407	L53 CMS X 0461	8,570	27.98	15.35	655	348	592	1762	66
424	(L29 X L21) CMS X A7111	8,386	25.34	16.55	465	295	419	1301	54
410	(L12 X C1) CMS X L8	8,078	23.00	17.55	435	391	242	1151	68

Table 4-1. (continued) Yield, sugar percentage and impurity factors for high sugar lines Farmington, Utah 1974.

Code	Description Hybrids	Acre Yield Gross Sugar	Acre Yield Tons Beets	Percent Sugar	Index	N	Na	K	Beet Count
415	(L29 X L20) CMS X L8	8,014	23.03	17.39	588	605	327	1218	70
420	(L29 X L21) CMS X L8	7,880	22.30	17.69	457	417	239	1219	66
409	L53 CMS X A7111	6,969	22.58	15.45	707	476	689	1494	48
419	(L29 X L20) CMS X A7111	6,887	20.82	16.43	481	325	473	1201	46
403	L29 CMS X 0461	6,886	21.91	15.79	542	296	483	1533	47
414	(L12 X C1) CMS X A7111	6,475	21.49	15.04	546	315	547	1247	46
405	L53 CMS X L8	6,226	18.61	16.76	588	501	407	1335	58
401	L29 CMS X L8	5,838	16.85	17.34	581	539	450	1235	31
404	L29 CMS X A7111	2,677	8.09	16.52	437	245	288	1490	13
	Inbreds								
434	L20	6,515	19.28	16.94	498	416	191	1431	63
432	L19	6,223	16.59	18.78	569	549	265	1706	70
435	L37	6,138	19.03	16.16	966	958	345	1887	65
436	L53	3,482	10.30	16.89	600	557	348	1288	52
433	L8	3,275	9.79	16.76	770	874	256	1302	43
Mean of all Varieties		8,153	24.53	16.68	559	433	388	1430	65
Standard Error		914	2.63	0.73	91	87	143	150	6.7
LSD (5% Point)		1042	3.01	0.83	103	98	161	188	7.5
C. V. Percent		11.2	10.7	4.4	16.3	20.0	36.8	10.5	10.3
Calculated F		32.85**	37.46**	8.47**	7.11**	17.54**	3.47	7.98**	33.34**

Table 4-2. Mean gross sugar (lbs/acre) for males and females in high sugar inbred test Farmington, Utah 1974.

Females	Males					
	L8	L19	0461	A7135	A7111	Mean
L29 CMS	5838.44	9865.19	6885.89		2676.83	
L53 CMS	6225.62	9407.55	8570.34	10666.18	6969.36	8368
(L12 X C1) CMS	8078.00	9432.12	9188.16	11115.54	6474.78	8853
(L29 X L20) CMS	8013.78	8976.24	8810.72	10635.49	6886.97	8665
(L29 X L21) CMS	7879.71	9051.32	8776.92	10548.09	8386.05	8928
Mean	7549	9217	8837	10741	7179	8705

Females = 1.9 ns F ratio
Males = 53.6**
F X M = 1.9*

LSD.05 between Hybrids = 1092
between Females = 488
between Males = 446

Table 4-3. Mean root yield (tons/acre) sugar percentage for males and females in high sugar inbreds Farmington, Utah 1974.

Females	Males					
	L8	L19	0461	A7135	A7111	Mean
L29 CMS	16.84	27.93	21.91	-	8.09	-
L53 CMS	18.61	25.88	27.98	32.88	22.58	25.6
(L12 X C1) CMS	23.00	26.75	29.16	33.24	21.49	26.7
(L29 X L20) CMS	23.03	24.82	27.67	32.04	20.32	25.7
(L29 X L21) CMS	22.30	25.41	27.14	32.24	25.32	26.5
Mean	21.7	25.7	28.00	32.6	22.6	26.1

Females = 1.30 ns F ratio
Males = 61.79**
F X M = 1.35 ns

LSD.05 between Hybrids = 3.15
between Females = 1.4
between Males = 1.6

Table 4-4. Mean sugar percentage for males and females in high sugar inbreds Farmington, Utah 1974

	Males					
Females	L8	L19	0461	A7135	A7111	Mean
L29 CMS	17.34	17.67	15.79	-	16.52	-
L53 CMS	16.76	18.20	15.35	16.22	15.45	16.4
(L21 X C1) CMS	17.55	17.63	15.75	16.73	15.04	16.5
(L29 X L20) CMS	17.39	18.07	15.94	16.60	16.43	16.9
(L29 X L21) CMS	17.69	17.78	16.13	16.39	16.55	16.9
Mean	17.3	17.9	15.8	16.5	15.9	16.7

Females = 3.77* F ratio
Males = 40.03**
F X M = 1.80*

LSD.05 between Hybrids = 0.82
between Females = 0.37
between Males = 0.41

Table 4-5. Mean ppm nitrogen for males and females in high sugar inbred test Farmington, Utah 1974.

	Males					
Females	L8	L19	0461	A7135	A7111	Mean
L29 CMS	539	426	296	-	245	-
L53 CMS	501	525	348	470	476	464
(L12 X C1) CMS	391	415	304	393	315	365
(L29 X L20) CMS	605	499	361	431	325	444
(L29 X L21) CMS	417	371	327	399	295	362
Mean	478.5	452.5	335	424.5	353	409

Females = 12.3** F ratio
Males = 13.5**
F X M = 1.59 ns

LSD.05 between Hybrids = 95
between Females = 43
between Males = 48

Table 4-6. Mean ppm sodium for males and females in high sugar inbred test Farmington, Utah 1974.

Females	Males					
	L8	L19	0461	A7135	A7111	Mean
L29 CMS						
L53 CMS	406.8	302.8	592.3	436.7	689.3	486
(L12 X C1) CMS	242.2	279.7	565.5	354.5	547.2	398
(L29 X L20) CMS	326.7	320.3	457.0	480.7	472.8	412
(L29 X L21) CMS	238.8	324.8	464.3	438.7	418.7	377
Mean	304	307	520	428	532	417.99

Females = 3.05* F ratio
Males = 13.4**
F X M = 0.9 ns

LSD.05 between Hybrids = 170
between Females = 76
between Males = 85

Table 4-7. Mean ppm potassium for males and females in high sugar inbred test Farmington, Utah 1974.

Females	Males					
	L8	L19	0461	A7135	A7111	Mean
L29 CMS						
L53 CMS	1335.5	1605.7	1762.2	1538.5	1494.0	1547
(L12 X C1) CMS	1151.2	1642.7	1274.0	1391.5	1247.7	1341
(L29 X L20) CMS	1218.0	1583.5	1374.5	1310.8	1201.3	1338
(L29 X L21) CMS	1218.8	1466.7	1381.7	1340.3	1301.3	1342
Mean	1231	1575	1448	1395	1311	

Females = 11.3** F ratio
Males = 14.6**
F X M = 1.3 ns

LSD.05 between Hybrids = 193
between Females = 86
between Males = 97

Table 4-8. Mean impurity index for males and females in high sugar inbred test Farmington, Utah 1974.

Females	Males					
	L8	L19	0461	A7135	A7111	Mean
L29 CMS						
L53 CMS	587.5	567.5	665.0	623	707.5	630
(L21 X C1) CMS	435.5	525.2	523.2	520.7	546	510
(L29 X L20) CMS	588	558.7	546	560.2	480.7	547
(L29 X L21) CMS	457.2	482.8	518.7	544.2	464.5	493
Mean	517	534	563	562	550	545

Females = 13.0** F ratio
Males = 1.09 ns
F X M = 1.1 ns

LSD.05 between Hybrids = 106
between Females = 48
between Males = 53

POWDERY MILDEW DISEASE READING

The powdery mildew disease was very prevalent in the Farmington area in 1974. The plant materials in test 4 provided a good opportunity to evaluate some of the Logan inbreds and hybrids as well as commercial varieties for this disease. Each plot in each rep was visually scored by D.L. Munford on a 0-5 scale where zero indicated no powdery mildew and 5 indicated extremely heavy infection.

The inbreds in the test averaged 1.44 compared to a mean of 3.0 reading for the hybrids (Table 4-9). Three of the inbreds had very low incidence of mildew infection. Hybrids having L8, L29 CMS, or (L12 X C1) CMS, as parents had the greatest mildew infection. A7135 and L53 CMS hybrids averaged the least incidence of mildew.

Table 4-9. Powdery mildew mean scores (1 = resistant - 5 = Susc.) for varieties in test 4 Farmington, Utah 1974.

Females	Males					
	L8	L19	0146	A7135	A7111	Mean
L29 CMS	4.0	3.0	3.2	-	3.0	3.30
L53 CMS	2.8	2.6	2.7	2.0	3.0	2.62
(L12 X C1) CMS	4.0	3.1	2.8	2.9	3.1	3.18
(L29 X L20) CMS	3.3	3.1	3.1	2.8	3.2	3.10
(L29 X L21) CMS	3.2	3.2	3.0	2.4	3.0	2.96
Mean	3.46	3.00	2.96	2.53	3.06	3.00

Commercial Varieties		Inbreds	
Tasco AH4	3.2	L19	2.3
Tasco AH11	3.2	L8	2.4
Tasco AH10	2.8	L20	1.1
Tasco AH1	3.1	L37	0.7
UI Hybrid D	2.9	L53	0.7
UI Hybrid B	2.6		
HH 22	3.1	Mean	1.44

Mean of all varieties	2.79
Standard error	.32
LSD (.05 point)	.36
C. V. percent	11.52
Calculated F	30.11**

GENOTYPIC COMPETITION BETWEEN SUGARBEET VARIETIES

Devon L. Doney

This is the third report of a continuing study concerning the effects of genotypic competition on selection. The past two reports dealt with the estimation of genotypic competition parameters. Last year selections were made in heterozygous competing systems for some of these parameters. Seed was obtained from most of the selections during the summer of 1974. This report deals with a two-genotype competing system.

The 1973 data indicated that plots having two competing genotypes will yield higher than the mean of the component genotypes in pure stand if one of the genotypes has high competitive influence. An additional test of this phenomenon was conducted in 1974. Seed from five commercial hybrids and two experimental hybrids were mixed in all possible two-genotype combinations. The percent germination and number of seeds per gram was measured on each hybrid before mixing. Each two genotype combination was then mixed to insure equal number of plants from each genotype. The component genotypes grown in pure stand were also included in this test. The field harvest data and the impurity data for this test are shown in table 1. There were significant differences between the hybrids (entries) for all measured characters (table 1). In no case was there a significant difference between the mix mean and the component pure plot mean (table 1). However, there were consistent differences for some genotypes. Every mix containing hybrid 8125 yielded better than the component pure stand mean yield. In fact, 4 of the 6 mixtures yielded more than the high component in pure stand (table 1).

There were significant differences in general competition for all characters except nitrogen and impurity index, while no character exhibited specific competition (table 2). Therefore, the genotypes were different in general competition but were consistent in competition with each other and did not interact with each other differently. A better picture of the general competitive ability is obtained by summing over all mixtures and component pure stand genotypes for each line (table 2). The mix plot mean was greater than the component pure plot mean for root and gross sugar yield of all lines except GWD2 root yield. The mix plot mean for hybrid 8125 was significantly greater than the component pure stand mean for root and gross sugar yield (table 2). The sugar percentages varied and were not consistently different. In general, the impurity characters (index, N, Na, and K) were smaller in the mix plot means than in the component pure plot means. Hybrids GWD2 and 8125 mix plot means had significantly smaller sodium concentrations than their component pure plot means (table 2).

These results tend to confirm the 1973 results. In both years hybrid 8125 exhibited high competitive influence (a positive influence

on the yield of its competing neighbor). Hybrid TASCO, AH3 showed some competitive influence in 1973 and a tendency toward competitive influence in 1974. All other hybrids tested both years gave no general competitive influence either year. Thus, competitive influence can be altered genetically and can be a factor for increasing yields in certain genotypic mixtures. Since specific competitive ability appears to be of little importance, selection for genotypic competitive influence can be measured by testing desirable genotypes with one common competitor rather than in all possible combinations.

Table 1. Genotypic competition test. Seven hybrids and each two - genotypic combination mixture.

Code	Description	Acre Yield Gross Sugar (lbs)	Acre Yield Tons Beets	Percent Sugar	PPM Index	PPM N	PPM Na	PPM K
711	USH20	6033	20.04	15.15	618	516	339	1148
722	Holly Hybrid 22	6302	20.90	15.07	624	500	232	1433
733	TASCO AH3	5371	17.71	15.13	576	470	269	1225
744	U&1 #D	5947	18.72	15.88	522	474	233	1082
755	GWD2	7249	22.97	15.82	600	531	206	1363
766	8125	5295	17.68	15.00	687	577	356	1303
777	1186 (A7126 X 0532)	6921	22.03	15.75	678	586	321	1462
712	USH20 + HH22	6275	21.27	14.75	606	473	327	1221
713	USH20 + TASCO AH3	5891	19.81	14.87	666	539	380	1261
714	USH20 + U&1 #D	5886	20.03	15.49	563	436	329	1261
715	USH20 + GWD2	6270	20.51	15.28	609	521	300	1206
716	USH20 + 8125	6290	20.51	15.33	588	505	289	1143
717	USH20 + 1186	6526	21.66	15.08	670	536	319	1444
723	HH22 + TASCO AH3	5771	19.76	14.57	611	464	250	1348
724	HH22 + U&1 #D	6232	19.95	15.61	539	453	192	1269
725	HH22 + GWD2	6562	21.32	15.41	620	536	176	1430
726	HH22 + 8125	6374	21.00	15.17	561	436	226	1342
727	HH22 + 1186	6393	20.65	15.50	630	496	311	1471
734	TASCO AH3 + U&1 #D	5491	17.52	15.68	504	429	229	1119
735	TASCO AH3 + GWD2	6739	20.54	16.41	530	489	175	1281
736	TASCO AH3 + 8125	5673	18.22	15.56	560	460	285	1244
737	TASCO AH3 + 1186	6495	21.24	15.27	661	537	293	1460
745	U&1 #D + GWD2	6670	21.35	15.60	588	535	180	1265
746	U&1 #D + 8125	6028	19.39	15.52	575	502	262	1179
747	U&1 #D + 1185	6387	20.00	15.91	590	518	273	1289

Table 1. Genotypic competition test. Seven hybrids and each two - genotypic combination mixture. (continued)

Code	Description	Acre Yield		Percent	PPM			
		Gross Sugar (lbs)	Tons Beets	Sugar	Index	N	Na	K
756	GWD2 + 8125	6607	21.32	15.49	617	539	192	1388
757	GWD2 + 1185	7007	21.88	16.00	567	485	262	1327
767	8125 + 1185	6486	20.60	15.75	641	561	350	1297
Mean of all Entries		6256	20.27	15.4	600	504	270	1295
Standard Error		634	1.89	0.69	79	75	65	155
LSD (5% Point)		732	2.1	0.78	91	86	74	180
C.V. Percent		10.1	9.3	4.4	13.1	14.9	24.1	12.0
Calculated F		3.41**	3.23**	2.12**	2.22**	1.88*	4.95**	2.97**

Table 2. The mix plot and component pure plot means of each line for each character.

Line	Description	Acre Yield: Gross Sugar(lbs)	Acre Yield: Tons Beets	Percent Sugar	PPM: Index	PPM: N	PPM: Na	PPM: K
USH20	Mix plot mean	6190	20.47	15.13	617	502	324	1256
	Component pure plot mean	6108	20.02	15.29	616	520	358	1230
HH22	Mix plot mean	6268	20.66	15.17	595	476	247	1347
	Component pure plot mean	6218	20.38	15.26	636	513	260	1348
TASCO AH3	Mix plot mean	6010	19.51	15.39	589	486	269	1286
	Component pure plot mean	5831	19.05	15.29	599	501	275	1262
U&I #D	Mix plot mean	6116	19.54	15.64	560	479	244	1230
	Component pure plot mean	6072	19.47	15.60	593	502	256	1203
GWD2	Mix plot mean	6643	21.16	15.70	589	518	214*	1316
	Component pure plot mean	6614	21.24	15.57	609	526	249	1319
8125	Mix plot mean	6243*	20.17*	15.47	590	501	267*	1266
	Component pure plot mean	5800	19.04	15.22	644	545	311	1294
1186	Mix plot mean	6550	21.01	15.59	626	522	301	1381
	Component pure plot mean	6478	20.85	15.54	641	548	294	1361
	LSD .05	254	0.71	0.28	65	48	26	62
	General Competition (F ratio)	12.03**	11.58**	4.91**	1.44	0.05	13.46**	7.40**
	Specific Competition (F ratio)	0.96	0.84	1.18	1.78	1.74	2.04	1.30

* = Significant difference between mix and component pure plot means at P = .05
** = Significant at P = .01

GENOTYPE X NITROGEN INTERACTION IN SUGARBEET HYBRIDS

D. L. Doney, D. W. James, and J. C. Theurer [1/]

This is the second report of a study to more definitely measure the genotype X nitrogen reaction. Previous studies have involved relatively few closely-related genotypes, and therefore, little genotype X nitrogen interactions have been found. We have attempted to broaden the genetic base to include different sugar and yield types. Twenty hybrids were selected that differed in their yield and sugar accumulation abilities. Included in this test were 4 commercial hybrids from different sugar companies. These were replicated (7 times) in a field very low in nitrogen fertilizer. One week after thinning nitrogen fertilizer was added in a split plot design as follows:

Treatment 1 = 0 Nitrogen
Treatment 2 = 75 lbs nitrogen per acre
Treatment 3 = 187.5 lbs nitrogen per acre
Treatment 4 = 469 lbs in nitrogen per acre

Nitrogen deficiency symptoms occurred on the 0 nitrogen level very early and on the 75 lb N/acre level the early part of August. At harvest time differences in nitrogen fertility could be observed between treatments 3 and 4.

The harvest and impurity data are shown in Table 1. There were significant differences between genotypes for all measured characters (Table 1). Nitrogen treatments caused big significant effects for all characters (Table 1). Root yield was increased for each progressive nitrogen treatment, however, the increase yield of treatment 4 over treatment 3 was not significant. The 0 nitrogen treatment was so low in nitrogen that the sugar percentage was affected. The highest sugar percentage was achieved for treatment 2. Treatments 1 and 3 were about the same in sugar percentage and treatment 4 greatly reduced the sugar percentage (Table 1). The highest gross sugar yield was with nitrogen treatment 3 (Table 1). The impurity factors increased with increased nitrogen (Table 1). A small beet count was obtained for the 0 nitrogen level because some of the roots were so small they fell through the harvester chain.

A significant genotype times fertilizer interaction was present for all characters except sodium and potassium (Table 1). The higher yielding more vigorous genotypes tended to respond more to the highest nitrogen level more than the high sugar types. This resulted in the significant yield and gross sugar interactions. Three genotypes gave highest sugar percentage at the fertilizer treatment 3 level, whereas all other genotypes' sugar percentages were highest at the treatment 2

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level. Some genotypes responded less to high soil nitrogen, i. e., accumulated less nitrogen in their roots at high fertility levels than other genotypes. This resulted in significant genotype X fertilizer interactions for the nitrogen and index characters (Table 1).

These data clearly indicate that genotypes differ in their response to nitrogen fertilizer particularly in their response to yield, sugar percentage and nitrogen accumulation. It is therefore, reasonable to assume that selection pressure in the appropriate direction could alter a genotype's response to high soil nitrogen levels. However, correlations between sugar percentage and the impurity factors adjusted for nitrogen level and for genotype gave much stronger relationship for nitrogen level eliminating genotype than for genotype eliminating nitrogen level. This means that much of the negative relationship between nitrogen and percent sugar is due to nitrogen level. The genetic relationship between nitrogen and percent sugar is very low and selection can be applied to each one of these characters independently.

Table 1. Nitrogen test. Total mean (over the four Nitrogen levels) data for each entry, Nitrogen means and F ratios from the ANOV table.

Code	Description	Acre Yield: Gross Sugar (lbs)	Acre Yield: Tons Beets	Percent Sugar	PPM: Index	PPM: N	PPM: Na	PPM: K	Beet Count
801	7114 X L37	6469	18.59	17.6	530	491	80	1572	72
818	U&1 #8	6144	17.72	17.4	427	373	96	1313	76
814	EL 35 X 0198S	6138	17.47	17.7	400	295	104	1459	61
804	(133 X CT5) X L19	6136	16.54	18.6	405	331	108	1500	73
811	OV X 0461S	6115	18.70	16.4	530	357	169	1756	67
815	EL 33 X 9450	6055	17.85	17.1	466	319	144	1650	67
820	TASCO Hy #11	5958	18.16	16.5	466	310	107	1639	72
802	(133 X 030.5) X A7135	5932	17.53	17.0	466	355	138	1500	68
819	Holly Hy 22	5915	18.29	16.3	484	305	109	1718	79
817	USH 20	5653	16.93	16.8	454	347	125	1425	65
805	U&1 Single Cross X L19	5630	15.23	18.6	424	394	81	1406	68
812	OV X CT9	5352	16.53	16.1	495	354	117	1588	65
808	(129 X OV3) X 0461S	5333	15.78	16.9	428	312	123	1453	62
810	(129 X OV3) X L19	5315	14.49	18.4	464	440	98	1474	62
813	A1-1 X 0198S	5305	16.03	16.6	397	261	131	1371	65
303	OV X A7135	5236	16.03	16.4	524	421	133	1489	63
816	(125 X 5A) X CT9Rf	5153	15.20	16.9	377	267	86	1351	61
306	(129 X OV3) X Klein E	5109	15.54	16.5	529	418	124	1589	62
309	(129 X OV3) X 133m	4931	14.63	17.0	531	413	132	1710	63
307	(129 X OV3) X A7111	4221	12.53	16.9	481	372	134	1526	40
	LSD .05	512	1.44	0.35	40	43	21	98	5
Treatment									
1	Nitrogen = 0	2901	8.41	17.25	333	164	95	1503	49
2	Nitrogen = 75 lb/acre	5787	16.26	17.77	337	213	100	1390	67
3	Nitrogen = 187.5 lb/acre	7026	20.26	17.35	455	381	118	1459	74
4	Nitrogen = 469 lb/acre	6706	21.02	15.98	736	668	155	1745	72
	LSD .05	484	1.42	0.34	35	32	17	95	4

Table 1. Nitrogen test. Total mean (over the four Nitrogen levels) data for each entry, Nitrogen means and F ratios from the ANOV table. (continued)

Code	Description	Acre Yield		Percent	PPM				Beet
		Gross Sugar (lbs)	Tons Beets	Sugar	Index	N	Na	K	Count
	Calc. F for genotype	9.46**	9.94**	34.5**	9.33**	13.4**	6.99**	11.4**	24.5**
	Calc. F for fertilizer	102**	120**	35.6**	217**	381**	20.7**	15.1**	25.3**
	Calc. F for gen. X fert.	4.52**	1.55**	1.51*	2.5**	3.5 **	1.2	0.95	0.63

Preliminary Study of the Effect of DPX3778 on Pollen Viability in Sugarbeet

J. C. Theurer

A new experimental chemical, DPX3778, has been reported as an effective agent to prevent pollen release in corn, wheat, rice and pearl millet. Greenhouse tests were conducted at Logan in an effort to evaluate the merit of this chemical as a gametocide for sugarbeets.

Photothermally induced steckling beets were planted in 6-inch pots in the greenhouse and foliar application was made of varied concentrations of DPX3778 with the aid of an atomizer sprayer. Check plants were sprayed with distilled water. Aerosol OT 75% Aq was used as an adhesive in all solutions.

In the first experiment, L8 plants were sprayed in the bud stage approximately one week prior to anthesis, with concentrations of 0, 50, 100, 500, and 1,000 ppm, DPX3778. All of the plants, regardless of treatment were fertile, shed pollen profusely and set seed.

Concentrations of the chemical were increased to 1,200, 2,500, 5,000, and 10,000 ppm for the next test with L8 and 7850 plant material. The control plants produced viable pollen. Plants given all other treatments showed a delay in seedstalk development and abnormal flowers that did not open. Leaves showed a tendency to curl and tip burn and necrosis became evident a week after spraying. The plant height and degree of leaf burning was correlated with the increase in concentration of the chemical. Microscopic examination indicated shrunken anthers with little pollen dehiscence and showed type II male sterile pollen.

In the next experiment, L8 and 7850 plants were sprayed twice: 10 days and 5 days prior to anthesis. Concentrations of 0, 50, 100, 500, and 1,000 ppm were used. All plants were fertile with good pollen dehiscence similar to the results of the first test.

L29 plant material was used in another test in pre-bud and early bud stages of development; at concentrations of 0, 100, 500, 1,000, 1,250, and 5,000 ppm DPX3778 and with one or two applications of the chemical. Plants sprayed with water, 100 and 500 ppm were normal in pollen development. In the 1,000 ppm treatment, plants were partially fertile with a fair amount of pollen dehiscence. The 1,250 ppm treated plants again showed abnormal flower development and curling of leaves. The 2,500 and 5,000 ppm treated plants were burned by the chemical and flowers were abnormal and remained closed. Plants treated in the early stage of development showed complete necrosis of leaves and 2-3 inches of the seed stalk tip was dead a week after spraying. Microscopic examination showed brown-yellow shrunken anthers with pollen grains that were fully formed but poorly stained.

Additional experiments are underway to complete the evaluation on this chemical, but preliminary results do not look favorable for its use as a gametocide in sugarbeet.

Studies on New Sources of Male Sterility

Beta Maritima Source:

Several different collections of Beta maritima were available at the Logan station. Male sterility had been noted previously in some of these lines. Crosses were made with male sterile segregates from four sources and the inbred L35. The best source from the species, AW129, was crossed with diverse pollinator lines.

Segregation data are given in the table below. Two of the male steriles (4911 and 8327) gave 100% fertile progenies with L35, and a third line had only one male sterile segregate of 37 plants. This would suggest that these male steriles are probably of the genetic type. The AW 129 male sterile segregated 13 MS: 6 PF plants when it was crossed with L35.

Two AW129 male sterile plants gave different readings when crossed with Rf-1. In crosses with L19 most of the progenies were fertile. None of the pollinators had an O type reading with the AW129 male sterile, although the cross with L22 showed predominately MS segregates.

Segregation of Beta Maritima MS Crosses

Cross	Fertility Reading		
	MS	PF	F
4911 MS X L35	0	0	70
8327 MS X L35	0	5	15
AW128 MS X L35	1	0	36
AW129 MS X L35	13	6	0
AW129 MS X Rf1	0	5	22
AW129 MS X Rf1	11	18	12
AW129 MS X L19	1	1	10
AW129 MS X L22	6	1	1
AW129 MS X L36	14	23	24
AW129 MS X A12	6	18	14
AW129 MS X 0591	9	5	7
AW129 MS X 0548	1	3	12

USSR Source:

John McFarlane received a line from Russia in 1973 (no. 644) that was reported to carry a source of CMS. Greenhouse evaluation of plants at Logan indicates this line is 100% fertile with excellent pollen dehiscence.

World Collection Source:

Seed of 315 lines from the Ames, Iowa introduction collection were planted in the field in the summer of 1974. There were 37 annual lines, 234 biennial lines and 44 lines segregating for growth habit. One or more male sterile plants were found in the field in 66 different introductions. However, upon transfer of these annuals to the greenhouse many field classified male steriles were fertile. Only 17 lines had definite male sterile characteristics. The type of male sterility, genetic vs cytoplasmic has not been determined yet for these lines. Biennial stecklings were harvested and will be evaluated for male sterility in the greenhouse in 1975.

Physiological Genetics

Devon L. Doney

A. Cytoplasmic Male Sterility

During the past year emphasis has been placed on obtaining more precise measurements of earlier plot study observations.

A more thorough investigation of the pH in developing anthers revealed a higher pH and not as drastic a drop in the pH during pollen development as previously reported. This more precise measurement was accomplished by extracting the contents of 4 anthers from an individual floret into 10 ul of 0.01N Na Cl solution. The pH was measured in a Markson micro-cup glass electrode using a standard Corning reference electrode. The remaining anther of each floret was used to determine the stage of anther development. The result of this study is shown in Figure 1. There was a rise in pH in normal anthers until shortly after tetrad formation. This was followed by a pH drop to about 6.5 shortly before anthesis and then an increase to about 6.8 at anthesis. The CMS anther pH was lower and the increase in pH extended further into the tetrad stage than normal anthers. The pH did not drop as soon as in normal anthers but when it began dropping it dropped to about the same level as reached in normal anthers. There was no rise in pH at anthesis because by this time complete abortion had taken place. We had previously observed that the tetrad stage in CMS anthers is about twice as long as the tetrad stage in normal anthers. Figure 1 is graphed to represent the approximate time-sequence of the stages of the normal and CMS anthers. In CMS anthers the microspores are not released from the callose wall until about the time that heavy exine is being formed on pollen in normal anthers. There was a slight increase in pH in both normal and CMS anthers at this time. This might be a sampling error, however this slight increase appeared to be consistent in all 5 experiments we conducted to measure pH.

Izhar and Frankel (1) reported that in petunia a lowering of the pH to below 6.5 is necessary to activate the callase enzyme that breaks down the callose wall surrounding the microspores. If this is the case in sugarbeet, a slower drop in pH would result in slower callase activity and a delayed release of the microspore from the tetrad, resulting in abortion. In earlier work we observed two esterase isozymes that appear in the anther at about the tetrad stage and disappear when the pollen reaches maturity prior to anthesis. An esterase cleaves an ester to form an alcohol and an acid. Theoretically, strong esterase activity would reduce the pH. Preliminary investigation into the activity of these two esterases in anthers suggested a reduced activity in CMS anthers. However, more detailed investigation revealed a different picture. We had been spraying with malathion and treating with temik to control thrips. In a study to make certain that these insecticides were not confounding our results, we discovered that temik was having a drastic effect on esterase activity. Figure 2 shows the esterase isozyme patterns of four separate experiments. Each plate in the figure is a

separate experiment. The isozyme bands are all from CMS anthers in the tetrad stage but from plants receiving different insecticide treatments. It can be seen from the figure that temik reduced the esterase activity in all cases.

A complete study of the anther esterase pattern from the pollen mother cells to mature pollen is shown in figure 3 for normal anthers and in figure 4 for CMS anthers. There is a difference in the esterase pattern of normal and CMS anthers. Densitometer readings indicated a slightly reduced esterase activity in CMS anthers, but not enough to explain the difference in pH change. The greatest difference in the patterns occurs at the time pollen is maturing in normal anthers.

References

1. Izhar, Shamay, and Rafael Frankel. 1971. Mechanism of Male Sterility in Petunia: The relationship between pH, callase activity in the Anthers, and the breakdown of the Microsporogenesis. Theoretical and Applied Genetics 41:104-108.

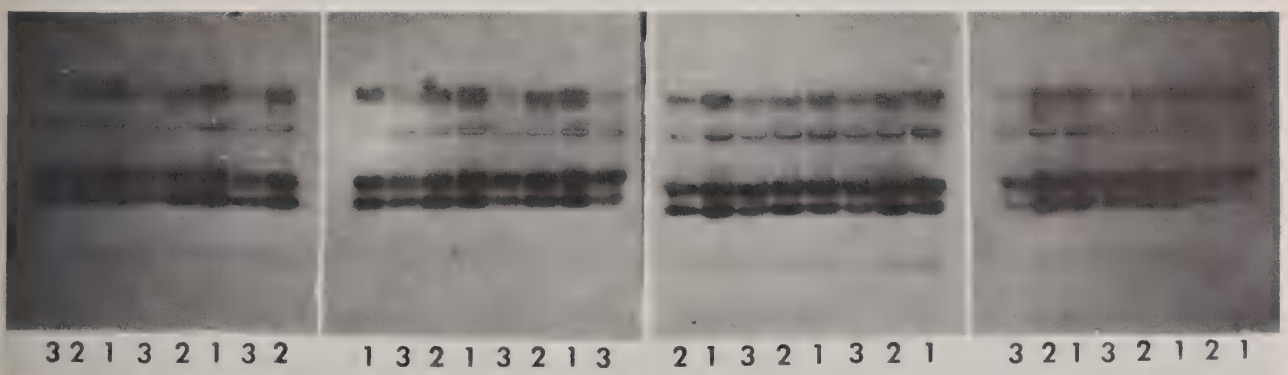

Figure 2. Esterase isozyme patterns in the anthers at the tetrad stage of development of CMS plants treated with: (1) control-no treatment; (2) malathion; and (3) temik. The two patterns to the extreme right were at very early tetrad stages and exhibited weak esterase patterns.

USDA 56 NURSERY TEST ENTRIES - 1974

Pandora, Ohio

Variety	PERFORMANCE AS % OF GENERAL MEAN RWSA	Tons/A	RWST	% Sucrose	% CJP	Beets /100'
SP7042-01 x FC506 x SP6822-0	107.07	107.27	99.5	100.03	99.75	103.96
SP7042-01 x FC506 x EL40	102.35	103.89	98.8	100.09	99.34	102.85
SP71550-01 x FC506 x SP6822-0	93.89	99.25	94.7	97.11	98.78	99.53
SP71550-01 x FC506 x EL40	97.21	93.33	104.1	103.20	100.44	106.17
UI100363-3 x FC506 x SP6822-0	109.53	112.34	97.5	97.62	99.99	99.53
UI100363-3 x FC506 x EL40	106.87	103.05	103.1	102.13	100.50	108.38
FC506ms x EL38 x SP6822-0	101.09	100.51	100.2	99.59	100.40	106.17
FC506ms x EL38 x EL40	87.04	84.46	102.6	101.94	100.36	96.22
SP7042-01 x EL38 x SP6822-0	102.86	105.16	97.4	98.83	99.29	106.17
SP7042-01 x EL38 x EL40	102.53	103.89	98.7	99.40	99.65	111.70
EL36C2 x EL38 x SP6822-0	97.78	102.20	96.3	97.11	99.61	105.06
EL36C2 x EL38 x EL40	95.69	100.94	94.7	96.10	99.32	101.75
SP71550-01 x EL38 x SP6822-0	95.23	94.60	99.5	100.09	99.76	103.96
SP71550-01 x EL38 x EL40	100.70	99.67	100.9	101.17	99.86	100.64
UI100363-3 x EL38 x SP6822-0	102.45	102.20	100.5	99.84	100.40	101.75
UI100363-3 x EL38 x EL40	103.34	98.82	104.2	102.25	100.99	108.38
UI100363-3 x EL36 x SP6822-0	100.91	104.74	96.6	97.37	99.66	99.53
UI100363-3 x EL36 x EL40	98.03	95.87	102.0	101.49	100.25	107.28
UI11866 x EL36 x SP6822-0	107.40	112.76	96.4	96.92	99.77	103.96
UI11866 x EL36 x EL40	102.86	103.47	98.9	98.38	100.33	111.70
SP69561-01 x SP7042-0 x SP6822-0	90.79	92.49	98.9	100.28	99.27	103.96
SP69561-01 x SP7042-0 x EL40	95.93	92.49	103.1	103.27	99.85	101.75
UI11866 x EL36 x SP6822-0	95.82	101.78	94.4	95.78	99.36	82.94
UI11866 x EL36 x EL40	90.95	90.38	99.9	99.52	100.22	98.43
UI11866 x EL36 x SP6528-01	109.66	107.69	101.6	99.90	100.92	98.43
UI100363 x EL36 x SP6528-01	97.68	98.40	99.1	99.27	99.96	94.00
SP7042-01 x UI12166 x SP6822-0	101.80	105.58	96.9	97.87	99.49	99.53
SP7042-01 x UI12166 x EL40	100.24	98.82	100.7	101.17	99.75	108.38
SP7042-01 x UI12166 x SP6528-01	103.65	102.63	100.9	100.82	100.07	108.38
EL36 x UI12166 x SP6822-0	98.75	99.67	99.1	99.21	99.99	95.11
EL36 x UI12166 x EL40	104.19	108.12	96.2	98.13	99.02	101.75
EL36 x UI12166 x SP6528-01	98.06	96.71	101.2	100.54	100.34	92.90
SP6926-01 x UI12166 x SP6822-0	101.89	104.74	97.4	97.87	99.83	98.43
SP6926-01 x UI12166 x EL40	115.37	108.96	105.7	103.84	100.90	105.06
SP6926-01 x UI12166 x SP6528-01	103.56	103.89	99.4	99.21	100.18	102.85
SP6926-01 x UI12166 x SP66288-24	102.29	104.74	97.7	97.37	100.25	105.06
SP6923-01 x UI12166 x SP6822-0	103.20	103.89	99.4	99.71	99.90	96.22
SP6923-01 x UI12166 x EL40	104.01	98.82	105.1	103.90	100.59	95.11
SP6923-01 x UI12166 x SP6528-01	103.45	101.78	102.3	101.30	100.50	98.43
UI11866 x UI12166 x SP6822-0 (USH20)	108.00	104.32	103.1	102.38	100.39	108.38
SP69561-01 x SP7042-0 x SP6922-0	102.50	96.29	106.0	105.24	100.33	100.64
SP69557-01 x SP68747A x SP6922-0	101.31	104.32	97.6	97.56	100.09	101.75
SP67550-01 x SP67569A x SP6922-0	95.28	93.33	101.6	101.17	100.22	101.75
SP68533-01 x SP67550-0 x SP72288-0	89.02	89.96	99.0	99.52	99.77	85.16
SP70550-01 x SP7042-0 x SP72288-0	79.60	78.97	100.1	100.28	99.96	78.52
SP67550-01 x SP67527A x SP72288-0	90.48	90.38	99.5	99.46	100.06	84.05
SP67550-01 x SP67557A x SP72288-0	80.98	79.82	100.6	100.48	100.05	66.35
SP67550-01 x SP67745A x SP72288-0	92.53	92.91	99.4	99.40	100.05	96.22
SP69561-01 x SP7042-0 x SP72288-0	86.65	87.00	99.0	100.09	99.46	86.26
SP70550-01 x SP7042-0 x EL40	101.22	94.60	106.9	106.32	100.15	107.28
SP7042-01 x EL36 x SP6822-0	96.78	95.45	101.1	100.92	100.10	98.43
UI102167E x EL36 x EL40	112.41	111.49	101.0	100.60	100.19	102.85
UI104366B x EL36 x SP6528-01	96.05	97.98	97.9	98.06	100.00	88.47
EL38 x EL36 x EL40	103.79	109.81	95.0	97.05	98.94	108.38
SP7042-01 x EL36 x SP6528-01	110.10	106.43	103.7	102.63	100.53	108.38
UI11866 x UI12166 x SP6822-0 (USH20)	116.98	116.56	100.1	99.21	100.56	108.38
LSD 5% =	14.31	13.81	5.01	3.63	0.90	10.69
GM =	6106.05	23.67	258.94	15.75	93.18	90.41
CV % =	12.58	12.14	4.40	3.19	0.79	9.40

Figure 3. Estarase isozyme patterns of normal anthers from: (1) Pollen mother cells to very early tetrad; (2) very early tetrad; (3) tetrad; (4) microspore; (5) pollen; and (6) stainable pollen (just prior to anthesis).

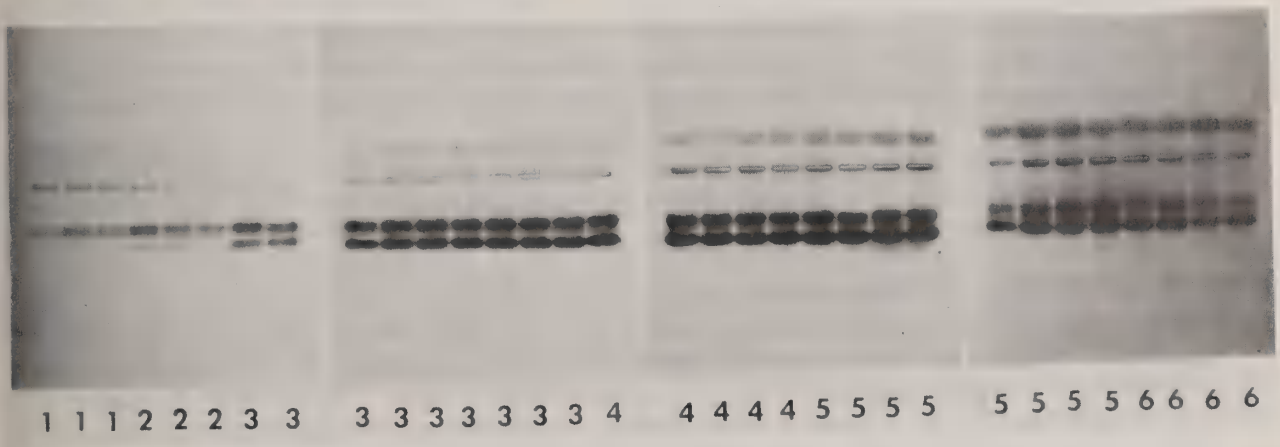

Figure 4. Esterase isozyme patterns of CMS anthers from: (1) pollen mother cells to very early tetrad; (2) very early tetrad; (3) tetrad; (4) microspore; (5) break down and abortion of microspore; and (6) complete abortion (just prior to flow opening).

B. Physiological Selection

The past few years we have been investigating physiological factors or traits for vigor and/or heterosis which can be measured in the laboratory with high precision. Three of the factors (mitochondrial efficiency, mitochondrial complementation and seedling respiration) have been reported earlier.

This report deals with some additional seedling factors. If factors responsible for vigor and/or heterosis could be determined and measured in the seedling stage, selection could be speeded up considerably. This study deals with the relationship of seedling characteristics with field yield and the effect of selection on certain seedling characters.

A series of ten hybrids that had been tested in the field at two locations was selected for the initial pilot test. These ten hybrids were planted in paper pots in vermiculite and grown in growth chambers. Ten plants of each hybrid were randomized in each of 8 flats. This made a total of 80 plants per hybrid. Each plant received equal amounts of nutrient solution daily. Data were taken on date of emergence, time of first true leaf, stomatal frequency of first true leaf and hypocotyl diameter at 11, 13, 15, 19, and 21 days after planting. Correlations were calculated between each measured character and field root yield.

Correlations of root yield with emergence, time of first true leaf, and stomatal frequency were near zero. The correlation between total plant weight and field root yield was a non-significant .40. The only character showing a significant relationship with root yield was hypocotyl diameter. There was a significant correlation at each date of measurement with the best correlation of .76 at the 21st day (table 1).

Since this inital pilot study, we have conducted an extensive investigation into the hypocotyl diameter character to ascertain its value as a breeding tool.

In 1973, the hypocotyl diameter was measured on seedlings of Test 7 and 8 during the summer before these tests were harvested. At harvest time root yields were taken and correlated with the earlier hypocotyl measurements. A highly significant correlation of .73 was obtained for Test 7 (table 4), whereas a non-significant correlation coefficient of .10 was obtained for Test 8 (table 5). The small differences between entries for both hypocotyl diameter and root yield in Test 8 may account for the poor correlation (table 5).

Several entries from some of the 1974 tests were measured for hypocotyl diameter. While these tests were not complete and could not be correlated directly with root yield, the ranking of each entry for hypocotyl diameter was the same as the ranking of these entries of root yield.

These tests were all within or between fairly close genetic

population. This relationship may not exist when comparing totally different populations. This is indicated by the check varieties (U&I #F and TASCO #3) in table 5. However, there does appear to be a definite relationship between hypocotyl diameter and root yield.

The next step was to determine the genetics of this character. The hypocotyl diameter was measured on seedlings of a 6 X 3 diallel cross that had been previously tested in the field at two locations. The correlation between the field yields and hypocotyl diameter for this diallel cross was .71 (table 2). The correlation coefficient between the general combining ability of the lines for hypocotyl diameter and root yield was .80. There were significant differences in general combining ability (males and females) and in specific combining ability (males times females) for both hypocotyl diameter and root yield (table 2, F ratios). In another test the parents were included in the 6 X 3 diallel. This test was measured at 17 days and is the reason for the smaller hypocotyl diameter measurement (table 3). The hybrids were larger than the parents in all but one cross. All but 3 hybrids gave significant heterosis (greater than the mid-parent) for hypocotyl diameter (table 3).

Selection for hypocotyl diameter was conducted in 9 heterozygous populations. In each test a uniform hybrid was included as a check to estimate the environmental variation. The F ratio between this estimated environmental variance and the population phenotypic variance gave a test of the genotypic variation for hypocotyl diameter (table 6). Five of the populations exhibited significant genotypic variation for hypocotyl diameter. Selections were made from each population (largest hypocotyl diameter). These selections were photothermally induced and selfed. The selfed progenies were then tested against the original population for any shift in hypocotyl diameter (table 6).

Selections from populations that exhibited little or no genetic variation were smaller in hypocotyl diameter then their parent population (table 6). This suggests that the selections from these populations were environmental variates and some inbreeding depression was present.

Selections from populations having significant genotypic variation had significantly larger hypocotyl diameter than their respective parent populations in 3 of the 5 populations. The size of the genetic variance as indicated by the F ratio was closely associated to the change in hypocotyl diameter of the selection progeny to their respective parent population (table 6).

These studies indicate that the hypocotyl diameter character is related to root yield, exhibit heterosis, general and specific combining ability and can be altered by selection in appropriate populations. It is probably a measure of the ability of a plant to expand in root diameter and is conditioned by additive and non-additive genes. Progress can be accomplished by selecting on an individual plant

basis, however a large environmental error exists and thus, restricts improvement to highly heterozygous populations. Research is currently underway to improve the precision and reduce the environmental error of this technique.

Table 1. Root yield and hypocotyl diameter of 12 hybrids

Hybrid	Root Yield Tons/Acre	Hypocotyl Diameter mm
29.53 CMS X 0532	27.7	2.41
A7113 X 0532	29.9	2.49
L53 CMS X 0531	26.5	2.58
FC506 CMS X 0531	19.2	2.12
UI#B X 0528	20.6	2.24
129 CMS X 0529	21.0	2.30
FC506 CMS X 0529	25.7	2.39
S33 CMS X 0529	21.6	2.00
Tasco #3	21.9	2.28
UI#D	25.4	2.26

Correlation Coefficient = .76**

Table 2. Root yield and hypocotyl diameter of a diallel cross

Females	Measurement	Males 0532	0531	0529	Mean
A7113	Hyp. dia.	3.051	3.053	3.119	3.074
	Rt. yield	29.9	22.2	25.2	25.8
L53 CMS	Hyp. dia.	3.335	3.080	3.160	3.192
	Rt. yield	30.0	26.4	25.7	27.4
U1#B	Hyp. dia.	3.188	2.820	3.141	3.050
	Rt. yield	26.6	21.4	24.6	24.2
29.53 CMS	Hyp. dia.	3.197	3.137	3.122	3.152
	Rt. yield	27.7	22.6	22.2	24.2
FC506 CMS	Hyp. dia.	3.042	2.793	3.182	3.006
	Rt. yield	25.5	16.2	25.6	23.4
129 CMS	Hyp. dia.	3.084	2.885	3.026	2.998
	Rt. yield	26.5	22.0	21.1	23.2
Mean	Hyp. dia.	3.150	2.961	3.125	
Mean	Rt. yield	27.7	22.3	24.1	

Correlation Coefficient = .71**

Correlation Coefficient (combining ability) = .80*

ANOV		F ratio
Males (GCA)	Hyp. dia.	6.58**
	Rt. yield	40.7**
Females (GCA)	Hyp. dia.	2.46*
	Rt. yield	6.78**
M X F (SCA)	Hyp. dia.	2.21**
	Rt. yield	2.32**

Table 3. Hypocotyl diameter and heterosis (difference from mid-parent) of diallel cross and parents

Females	Measurement	Males 0532	Males 0531	Males 0529	Mean	Parent
A7113	Hyp. dia.	1.863	1.730*	1.805*	1.800	1.721
L53 CMS	Hyp. dia.	1.798	1.802*	1.840*	1.813	1.747
U1#B	Hyp. dia.	1.945*	1.992*	1.462	1.800	1.796
29.53 CMS	Hyp. dia.	1.962*	1.876*	1.828*	1.888	1.582
FC506 CMS	Hyp. dia.	1.904*	1.647*	2.007*	1.850	1.584
129 CMS	Hyp. dia.	1.849*	1.654*	1.759*	1.754	1.530
Mean	Hyp. dia.	1.887	1.783	1.783		
Parent		1.688	1.295	1.446		

* = Significant heterosis (greater than mid-parent) at p = .05

Table 4. Root yield and hypocotyl diameter for Test 7, 1973.

Entry	Root Yield Tons/Acre	Hypocotyl Diameter mm
b73	23.98	2.32
b74	22.72	2.48
b76	23.63	2.35
b77	16.83	2.06
b82	20.65	2.26
b84	21.38	2.21
b86	14.79	2.01
b96	25.14	2.23
b98	24.10	2.27
b103	19.83	2.26
b107	20.07	2.27
b108	20.48	2.31
b109	25.20	2.30
b110	25.03	2.36
Tasco #3	21.00	2.31
LSD.05	3.18	.22

Correlation Coefficient = .73**

Table 5. Root yield and hypocotyl diameter for Test 8, 1973

Entry	Root Yield Tons/Acre	Hypocotyl Diameter mm
0180 X AN013-2	22.81	2.425
0180 X AN073	21.88	2.388
809 CMS X AN013-2	19.89	2.353
A923 X AN073	20.18	2.365
A7113 X AN013-2	20.18	2.425
A7113 X AN073	20.65	2.365
953 CMS X AN013-2	18.58	2.452
953 CMS X AN073	21.96	2.449
953 CMS X AN093-1	23.83	2.421
953 CMS X AN094-1	21.93	2.340
UI#F	20.27	2.237
Tasco #3	18.05	2.403
LSD.05	2.44	.200

Correlation Coefficient = .10

Table 6. F ratios for genotypic variance of the parent populations and hypocotyl diameter means for selections and their respective parent.

	F ratio (for genotypic variance of Parent Population)	Population Mean	
		Parent	Selection
C18	4.08**	3.28	3.59[a]
C21	0.96 NS	1.84	1.77
b75	1.31 NS	1.98	1.79[b]
b77	3.15**	3.26	3.71[a]
b84	0.91 NS	3.30	3.03[b]
b92	4.17**	2.14	2.93[a]
b96	1.92**	2.27	2.07
b97	1.24 NS	2.83	2.75
b109	1.92**	2.12	2.02

** = Significant genoypic variance at p = .01
a = Selection mean significantly larger than parent mean at p = .05
b = Selection mean significantly less than parent mean at p = .05

Potential Use of Plant Breeding to Reduce Sucrose Loss in Storage

R. Wyse, J. C. Theurer, D. L. Doney

During the past 4-5 years we have tested inbreds and hybrids to determine their ability to conserve sucrose during storage. The entries in these tests represented a wide genetic background from several sources. The results of these tests indicated a 3-4 fold range between entries in sucrose loss as determined by conventional polarimetric methods and a similar range between entries in respiration rates.

Results of preliminary crossing studies indicated potential for genetically reducing storage respiration rates.

Correlation Between Sucrose Loss and Respiration Rate

In 1973 twenty-one hybrids and inbreds were stored for 160 days at 5 C (40F). During this period the respiration rate was measured three times at approximately 50-day intervals. Sucrose analyses were made at harvest and after 160 days. Pol sucrose values were corrected for weight loss and errors due to the presence of raffinose and invert sugars. The total amount of sucrose respired was calculated by integrating the area under the respiration curve. A comparison of estimating sucrose loss by chemical means and by respiration is given in Figure 1. The correlation coefficient ($R = 0.85$) was highly significant. These results indicate that respiration rate is a valid method of evaluating the ability of breeding lines to conserve sucrose in storage. This affords a considerable advantage since the respiration measurement requires fewer replications, fewer roots and is much more precise than is the chemical sucrose measurement.

In 1974, 8 entries from the 1973 experiment representing the highest, lowest, and average respiring entries were again tested. The respiration rate after 100 days of storage was slightly higher in 1974 (Table 1), but the ranking of the varieties was very similar in the two years. This was true except for the hybrid L-53 X L19 which respired much higher in 1974. From this and other similar experiments respiration appears to be reasonably consistent from year to year.

We also measured the respiration rate of a diallel cross after 30 days of storage at 5^{o} C. This cross included the parents (8), F_1's (28), but no reciprocals and was analyzed according to Griffings Method 2. There were significant differences between hybrids and between inbred parents (Table 2). The hybrids generally had lower respiration rates than the inbred parents. Mean respiration rates combined over all crosses for each inbred gave significantly lower hybrid respiration rates than the inbred parents. (Table 2). This suggests heterosis for low respiration rate. In addition, the highly significant general and specific combining abilities (Table 2) indicated that respiration rate is conditioned by both additive and non-additive gene action.

The inbreds utilized in this diallel were not selected for their respiration characteristics. Therefore, the differences between inbred and hybrids are not indicative of the potential improvement to be gained by selection for respiration rate.

Therefore, respiration is an excellent method of predicting the ability of genetic material to conserve sucrose under good storage conditions. However, respiration does not predict the massive physical deterioration which occurs in some varieties after 120-140 days of storage. Respiration reflects the degree of rot in a sample but does not predict the ability of a root to resist mold invasion.

Summary

1. A high correlation exists between respiration rates and sucrose losses in cultivars stored at 5C in the absence of mold and desiccation.

2. Heterosis exists for low respiration.

3. Some dominant genes exist which influence low respiration.

4. Additive type genes exist for high or low respiration.

5. Genetic variation exists for 2, 3, 4 above.

6. Selection can be effective in reducing respiration.

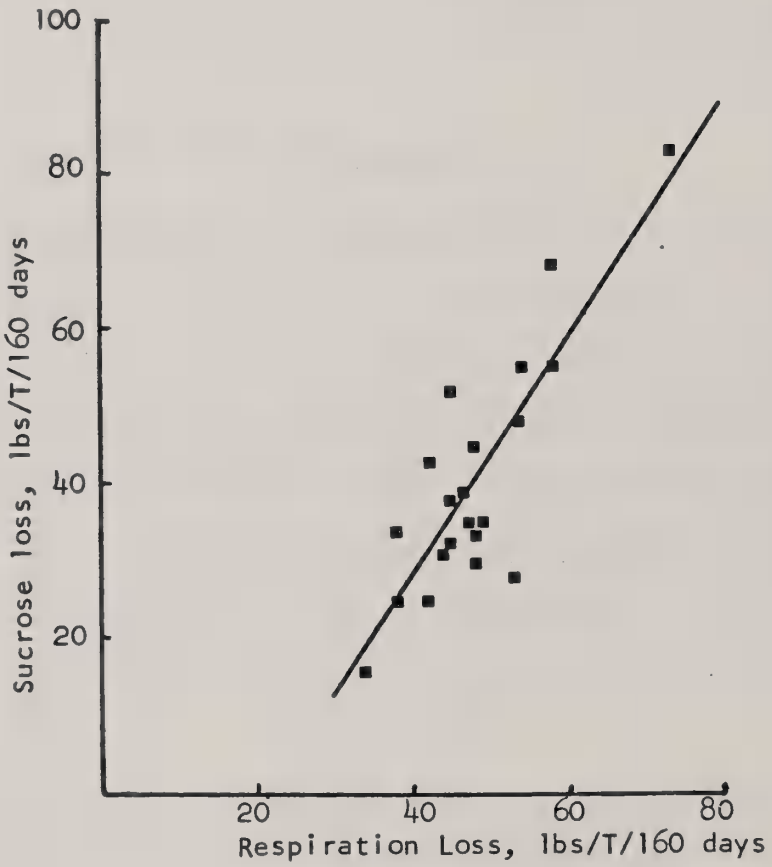

Figure 1. Correlation between the loss in gross sucrose and predicted loss based on integrated respiration rates.

Table 1. Comparison of year to year variation in the respiration rate of eight selected cultivars.

Entry	Respiration Rate 1973	1974
	lbs/Ton/day	
EL 31	0.349	0.496
L-19	0.334	0.353
CT9 X 133	0.268	0.309
129	0.265	0.321
L-53 X CT9	0.234	0.268
CT9	0.231	0.296
L53 X L19	0.203	0.353
L53 X 129	0.190	0.265
Mean	.258	.334
LSD .05	.040	.044

Table 2. Diallel cross respiration rate for parents, hybrids and parent and hybrid means for each inbred as well as combining ability F ratios.

Females	Males L29	L33	L53	A1	A4	A5	E1	F_4	Means Parent	Hybrids
				Mg CO_2/Kg/hr						
L29	8.61[1/]	8.45	6.26	6.23	6.91	6.40	7.22	6.32	9.24	6.83
L33		9.93	6.45	7.73	6.88	6.92	7.66	8.18	9.81	7.47
L53			10.52	6.72	6.62	7.02	8.27	6.63	10.06	6.86
A1				9.09	8.82	7.07	7.65	8.01	9.45	7.46
A4					9.91	6.05	7.93	7.70	9.80	7.27
A5						10.13	7.05	6.90	9.90	6.77
E1							9.26	8.12	9.52	7.70
F_4								10.31	9.97	7.41
LSD .05 = 1.50 (between individual hybrid and/or parents)									0.40	0.51
LSD .05 = Between each parent mean and hybrid mean comparison									0.56	

General Combining Ability = 6.66**
Specific Combining Ability =5.50**

** Significant at p = .01

[1/] Multiplying times 0.0312 converts to lbs sucrose/ton/day

Effect of Fluctuations in Storage Temperatures on Sugarbeet Storage Life

Roger E. Wyse

Optimum storage temperatures and the magnitude of temperature fluctuations which can be tolerated are important factors to be considered when designing permanent and semi-permanent sugarbeet storage structures. During the past two years studies were made to determine the effect of fluctuating temperatures on sugarbeet root respiration in storage. Respiration was used as an index of the rate of sucrose loss.

METHODS

In 1973-74 the roots utilized in the temperature fluctuation studies had been previously stored for 120 days at 5 C (40F). Ten samples consisting of 8 roots each were placed in the respirometer at an initial temperature of 5 C (40F). The temperature of the roots was monitored continuously with thermocouples imbedded in the outer 1cm and at the center of one root in each sample pail. The respiration rate was monitored once every 3 hours.

In 1974-75 freshly harvested roots were sorted into 13 storage treatments consisting of 10 samples of 8 beets each. The storage treatments were as follows: storage at a constant 30, 35, 40, 50-55; weekly fluctuation between 30 + 35, 30 + 40, 30 + 50, 35 + 50, 40 + 50 or storage at a constant 40F except for 1 week per month when the samples were moved to 30, 35, or 50F. Although the samples were rotated as described, due to lack of sample capacity at all temperatures respiration rates were not measured on all samples every week. The respiration rates were monitored twice daily but the data reported is the equilibrated rate after approximately 5 days at each temperature.

RESULTS

In the first experiment in 1973-74 the temperature was decreased from 40 to 34F during a 24-hour period and then held steady for approximately 2 days. During this time respiration decreased by 50% (Fig 1). At this point the temperature was decreased to 30F during a 24-hour period and then held constant for 6 days. As the root temperature reached 30F a sharp rise in respiration occurred. In subsequent studies this has proven to be a consistent pattern. At 30F the roots have frost on the surface but the root tissue itself is not frozen. Respiration decayed to a constant rate slightly higher than the rate at 34F. As the root temperature increased to 40F the respiration rate rose 6 fold (circles indicate temperature) but then stabilized at a rate almost double the original 40F rate. This increased rate undoubtedly reflects internal tissue injury.

In a second experiment the temperature was cycled between 28 and 34F (Fig 2) This small fluctuation resulted in a 3-fold increase in

respiration rate. These results demonstrate a high degree of sensitivity by the sugarbeet root to small temperature fluctuations at near freezing temperatures. After cycling the temperature at near freezing the temperature was rapidly lowered to 0F. The hatched area indicates the time during which the beets were frozen. The respiration rate dropped rapidly to near 0 at 0F. However, respiration started again as the temperature increased even though the roots were still frozen solid. As expected when the roots thawed the respiration rate increased rapidly as the roots quickly deteriorated.

In a third experiment the temperature was decreased from 40 to 0F very slowly. This slower rate of cooling made it possible to determine the temperature at which respiration stopped (Fig 3). The typical spike was encountered as the temperature passed 30F. The respiration rate decreased gradually until about 17F when the rate declined sharply to near zero. However, respiration was still detectable at very near 0F. As found previously when the temperature of the root increased the respiration rate also increased even though the roots were still frozen. Note that the root temperature was still below 30F when the experiment was terminated.

The objective in 1974-75 was to determine the effect of weekly temperature fluctuations of varying magnitude on sucrose losses. The data in Figures 4A to 4F are plotted as the equilibrium rate for the week and temperature tested. The samples were rotated between the temperatures shown each week even though no respiration measurement was made.

The data in figure 4A represent the respiration rate of roots stored at a constant 30,35, 40, or 50F. The three lowest temperatures are relatively flat indicating that the beets remained in excellent condition. There is very little advantage to storing beets at temperatures below 40F. In contrast the roots at 50F show a rising respiration rate and had visible signs of mold after about 8 weeks of storage. Comparing the remaining figures to figure 4A it is readily apparent that any fluctuation in temperature reduces storage life. However, the 35-40 treatment (Fig 4C) appears to be the least detrimental up to 12 weeks of storage. These results also confirm the previous years results that temperature near freezing reduce storage life. In all treatments with 30F as one temperature the upward slope indicates reduced storage life.

The wide temperature fluctuations of 40-50 and 35-50 did not affect storage life at the low temperature. Obviously sucrose loss is greater because of the higher average respiration rate but no accelerated rate of deterioration was noted.

From a practical standpoint these results indicate that outside air below 30F should not be introduced into a beet storage pile. The only time colder temperatures would be warranted is when pile temperatures are excessively high and the losses due to high temperature would offset the reduced storage life induced by excessive cooling.

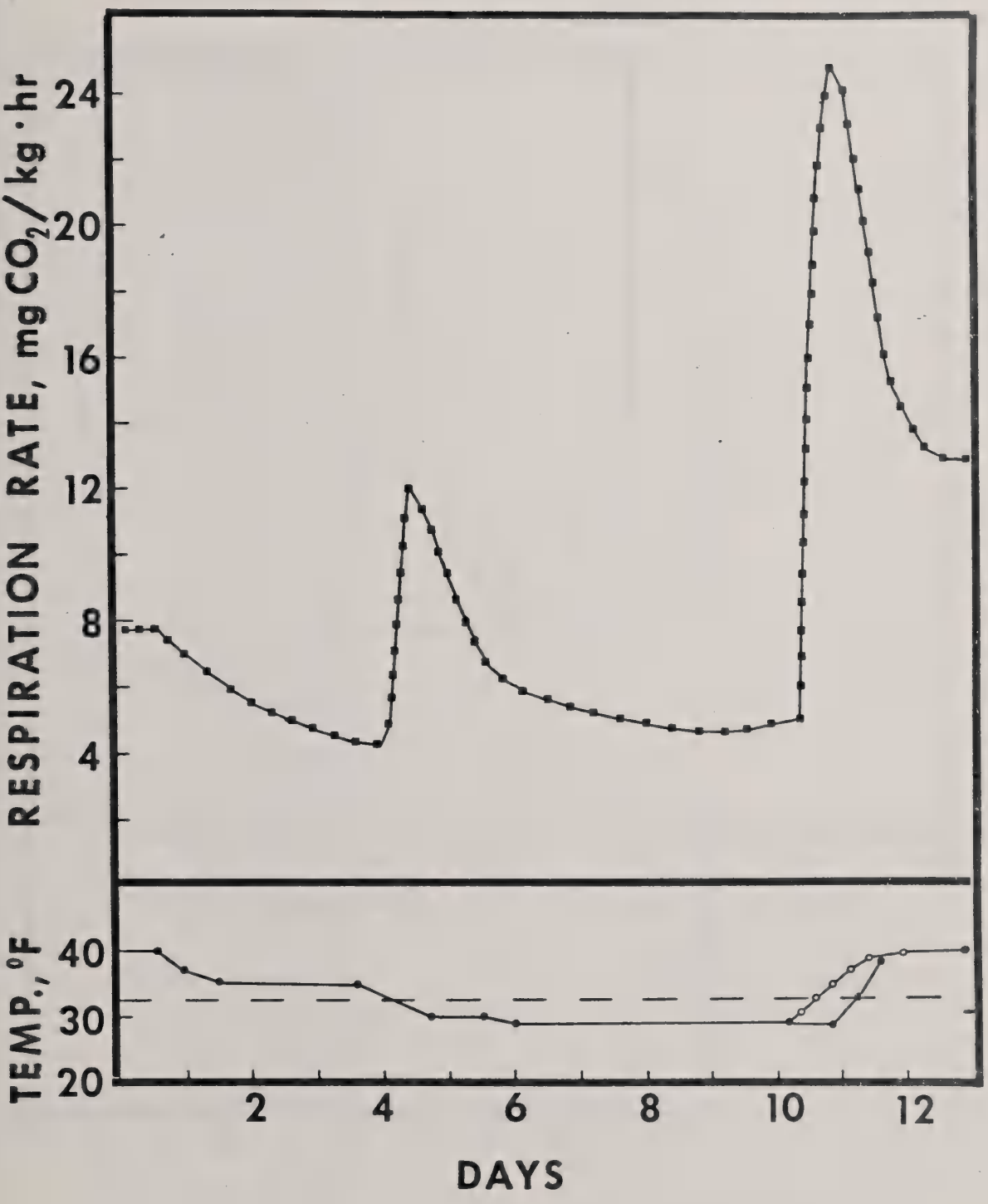

Figure 1. Respiration rate of sugarbeet root between 28 and 40°F.

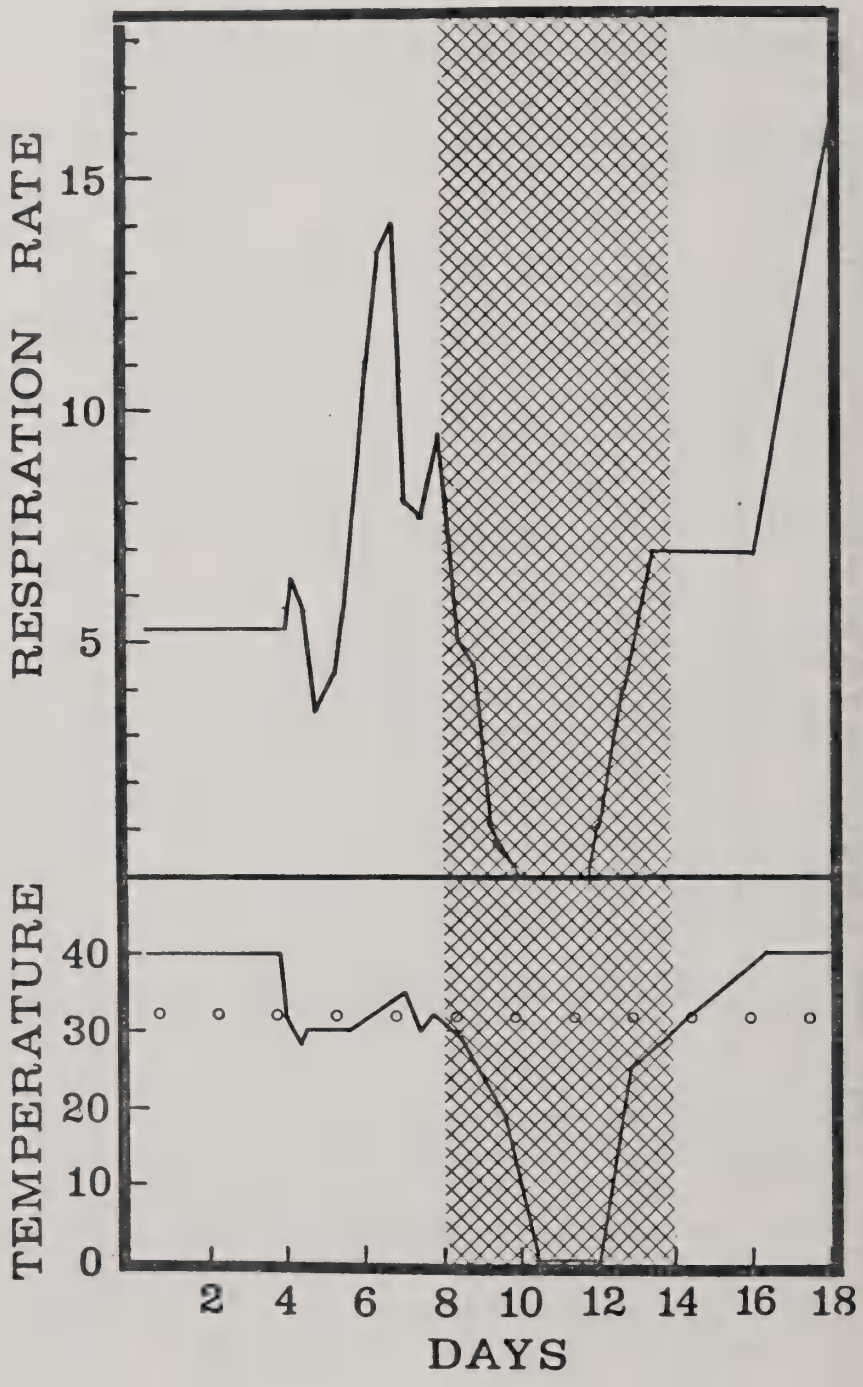

Figure 2. The effect of freezing and temperature fluctuations between 28 and 34°F on sugarbeet root respiration.

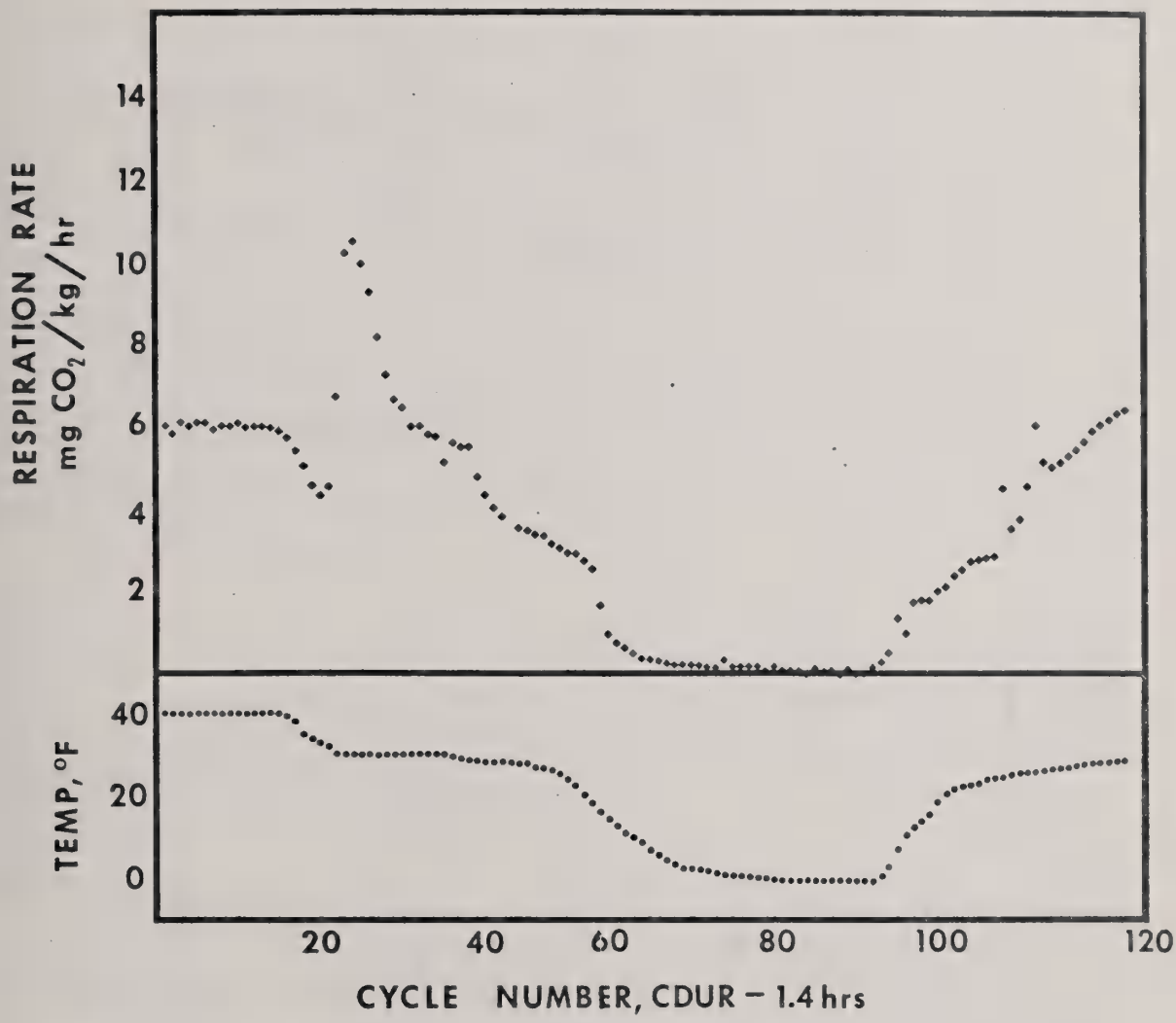

Figure 3. Respiration rates observed when temperatures were slowly decreased from 40 to 0F.

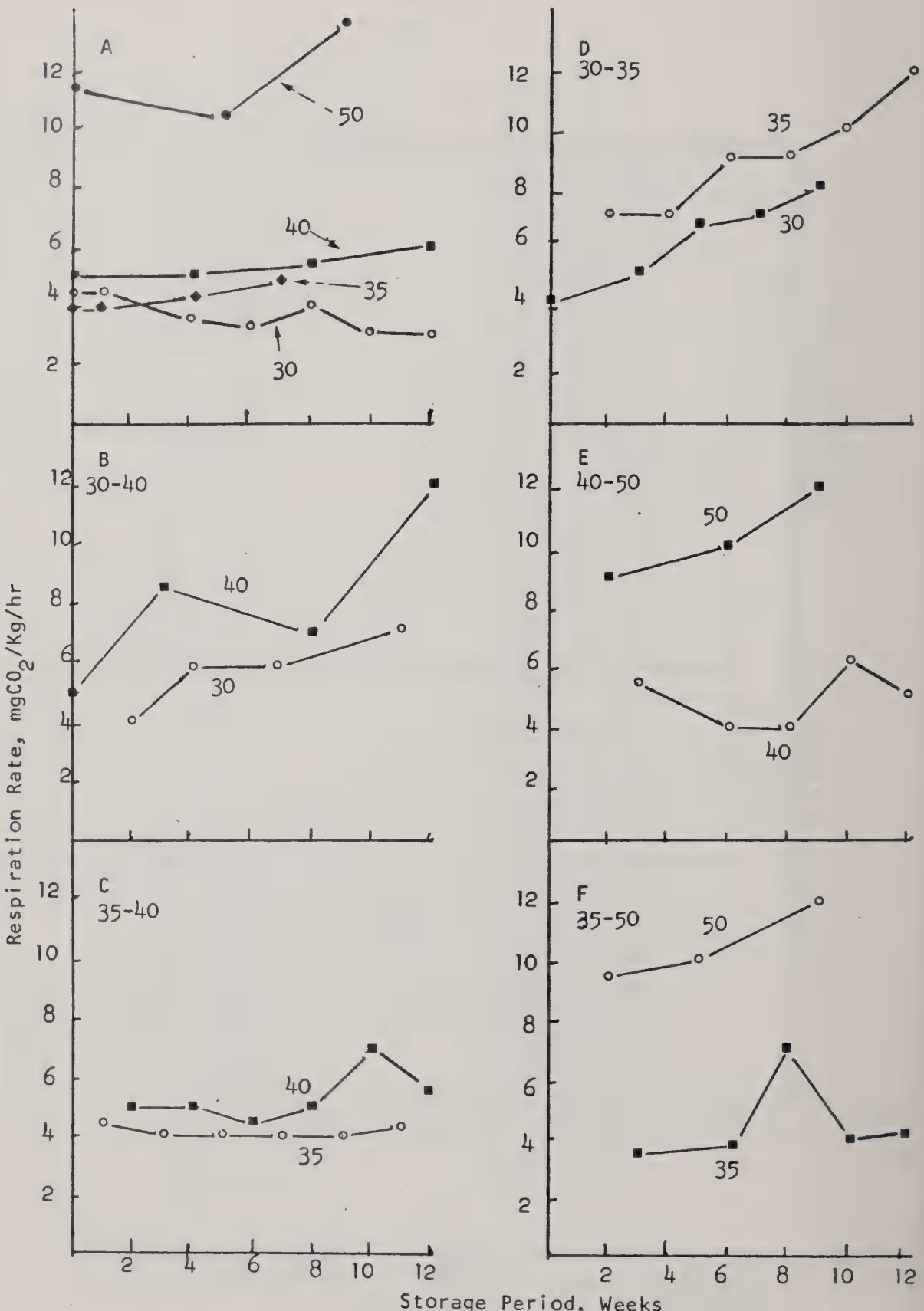

Figure 4. The effect of weekly temperature fluctuations of varying magnitude on sucrose losses.

Simulated Effect of Topping Injury on Pile Temperatures and Sucrose Losses During the First Week of Storage in Covered Piles

Roger E. Wyse

The development of improved sugarbeet storage techniques has made it possible to control pile temperatures and thus to greatly reduce storage losses. However, these structures, rigid, canopy or air support, greatly reduce the margin for management error. For example, if a "hot spot" develops, physical removal of the affected beets is essentially impossible. Therefore, these new storage techniques make it necessary to be able to predict the behavior of beets placed in these structures, based on their immediate history.

The purpose of this study was to determine the effect of topping injury (removing the crown at the lowest leaf scar) on respiration rates in storage. A model was developed to predict sucrose loss and pile temperature during the first week of storage based on temperature of beets at harvest, and the availability of cool night temperatures for ventilation.

Methods

Roots were harvested with a "crotch" lifter to minimize injury and separated into two lots. In one lot the crown tissue was removed to the lowest leaf scar, in the other only the petioles were removed. The lots were divided into 10 replications of five roots each and placed in the respirometer within six hours after harvesting. The first stable respiration readings were taken six hours later.

Model Assumptions

1. The model assumes that the roots are placed into a storage structure where heat loss is negligible without ventilation.

2. A Q_{10} of 2. This is conservative. Experimental evidence indicates this factor may be as high as 3.5 between 40 and 50F.

3. Ventilation air flow is 10CFM/Ton.

4. 70% RH of intake air and 98% RH of exit air.

5. Exit air temperature to be 0.7 (RT-NT) where:

RT = Root temperature
NT = Night temperature

6. In the temperature range of 35-60F (1.6-15C) the enthalpy of air is 0.66 BTU/lb.$^{o}_{F}$ (conditions of 4 assumed).

7. The specific heat of sugarbeet roots is 0.875BTU/lb.$^{o}_{F}$.

Input Variables

a. Night temperatures

b. Root temperatures

c. Hours of ventilation

Results

Respiration Rates of Topped and Untopped Roots

The respiration rate of topped and untopped roots during the first eight days of storage is given in Figure 1. The topped roots respired 2.5 times faster than the untopped roots during the first day after harvest and then declined rapidly to a rate which after 5 days was slower than the untopped roots. The very high rate immediately after harvest would contribute considerable heat into a covered pile. The effect of this heat on pile cooling will be discussed later.

The lower respiration rate of the topped roots after 5 days is rather surprising in light of the known effects of injury on root respiration. A possible explanation is that the crown tissue respired at a much faster rate than did the root tissue.

To test this possibility the equilibrated respiration rate of intact roots, topped roots, and the crown tissue from the topped roots was determined at 5C after 1 week of storage (Table 1). The crown tissue respired much faster then did an equivalent weight of topped root tissue. By factoring the respiration rate by weight and adding the crown and topped roots together, it is possible to estimate the increased respiration rate due to topping injury. The increase was only 0.021 lbs/T/day or 13.7%. Therefore, the major effect of topping is in the first few days after harvest. However, later in storage the topped beet may show an increased susceptibility to mold growth in the exposed hollow crown.

Prediction of Pile Temperatures

The pile temperature of topped and untopped roots was predicted for root temperatures of 15C(60F) or 10C(50F) at harvest and where night temperatures of 10C(50F), 5C(40F), or 1.6C(35F) were available for 0, 6, 12 or 24 hours. The results are given in figures 2 and 3.

Beets entering a pile at 15C(60F) required at least continuous ventilation with 10C(50F) air, 12 hours of 5C(40F) air or 6 hours of 1.6C(35F) per day to maintain or reduce pile temperature. In topped beets 10C(50F) air would not control temperature and longer ventilation

times of nearly 18 hours are required at 5C and 1.6C. However, in practice if the beet roots are at 15C(60F) night temperatures below 5C(40F) for 18 hours would be unlikely. If a similar situation developed in a permanent structure emergency refrigeration equipment would be required to maintain temperature.

If the initial root temperature is 10C(50F) untopped roots could be maintained at or below 10C(50F) with 12 and 6 hours of ventilation with 5 and 1.6C air, respectively. However, the topped roots again required 18-24 hours of ventilation to maintain or reduce temperature.

The model appears to give realistic comparisons on pile temperature and ventilation times. However, the model is based on a ventilation air temperature increase through the pile of 0.7 times the difference between the intake and exit air. In a beet pile 20 feet high this temperature increase would occur in the first 8-10 feet above the ventilation tubes. The result would be a gradual cooling above this level as the beets below cooled. Therefore, on a whole-pile basis the curves would be similar in shape but extend over a longer time.

The effect of the higher temperature and respiration rates of topped roots is evidenced in the predicted sucrose loss due to respiration during the first week of storage.

The data in table 2 indicate the importance of the losses during the first week of storage. For example, assuming the beets entered the pile at 15C(60F) and the beets were ventilated with 1.6C(35F) air for 12 hours each day for the first week the sucrose loss would be 7 lbs. The temperature would be 15C (Fig 2) at the end of the week but starting down. If after the second week the temperature was at 5C the losses for the week would be another 5 lbs. This is the total loss of 12 lbs/ton during the two weeks required to bring the temperature to 5C (normally in the Intermountain area 30-35 days is required). At 5C the respiration loss is approximately 0.15 lbs/T/day. Therefore, for a 100-day storage period the losses due to respiration would be 12+(86 x 0.15) = 24.9 lbs/ton. The losses during the first two weeks would account for 50% of the total. Therefore, efforts to reduce storage losses should be concentrated on the first two weeks of storage. This includes reducing injury and piling beets at lower temperatures.

A possible method of reducing losses during the first week of storage would be to use portable refrigeration equipment to cool the pile with 1.6C(35F) air for 24 hours immediately after piling. The model was used to estimate the sucrose conservation expected from such a practice (Table 3).

When roots enter the pile too warm (15C, 60F) refrigeration during the first 24 hours would realize a considerable savings of sucrose. Although 24 hours of refrigeration and 6 hours per day of ventilation with 10C air would save 2.3 lbs/T over no refrigeration, pile temperatures would still

not be under control after 1 week. Assuming a savings of 1 lb/T and a refrigeration unit with the capacity to remove the heat of respiration from 1,000 tons of beets during the initial 24 hours of storage (a 20-ton unit would be required) a sugar price of $.40 per pound and a piling time of 20 days, the gross savings per refrigeration unit would be $8,000. Obviously equipment and operating costs would considerably reduce these savings.

To reduce the pile temperature to 5C(40F) within 24 hours would require the removal of 28,200 BTU/ton of topped beets at an initial temperature of 15C(60F). This would save approximately 12 pounds of sucrose per ton or $4.80. The elimination of topping and injury would reduce the BTU load to 22,096/ton

It appears that refrigeration equipment would be justified in those areas normally having high harvest temperatures and insufficient cool night temperatures to control pile temperature during the first several weeks of storage.

Summary

High respiration rate during the first few days of storage is a prime contributor to the "sweat" period and high sucrose losses during the early part of the storage period. Losses during the first two weeks of storage may account for 30-50% of the total loss during a 100-day storage period.

Losses in storage can be minimized by storing cool beets and the use of refrigeration.

The very preliminary model needs considerable modifications to better correlate predicted and actual pile temperature trends but appears to be an excellent aid in developing storage management practices.

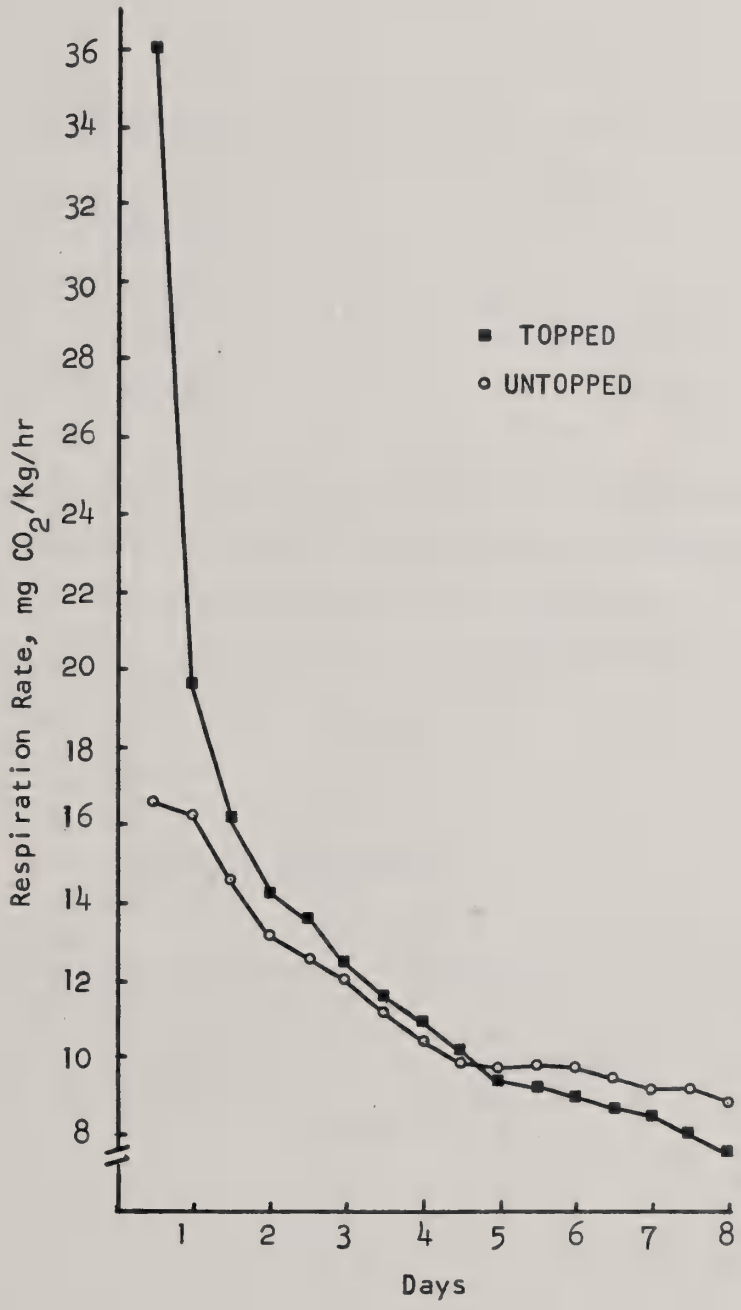

Figure 1. Respiration rate of topped and untopped roots during the first week of storage at 10C(50F).

Table 1. Effect of topping on root respiration rates at 5C

	Respiration Rate lbs/T/day	Fresh Wgt gms
Untopped root	.159	1,000
Topped root	.140	866
Crowns	.440	134

Respiration rate of an intact root based on the proportioned average of the respiration rate of the topped root and crown:

$(0.866 \times 0.140) + (0.134 \times 0.440) = 0.180$ lbs/T/day

Increased respiration due to topping injury:

$0.180 - 0.159 = 0.021$ lbs/T/day or 13.7%

LEGENDS FOR FIGURES

Figure 2. Simulated pile temperature of topped and untopped roots during the first week of storage. Initial root temperature was 15C(60 F). NT is the average night or ventilation temperature. Ventilation time per day: △ , 6 hours; • , 12 hours; ▽ , 24 hours.

Figure 3. Simulated pile temperature of topped and untopped roots during the first week of storage. Initial root temperature was 10C(50F). NT is the average night or ventilation temperature. Ventilation time per day: △ , 6 hours; • , 12 hours; ▽ , 24 hours.

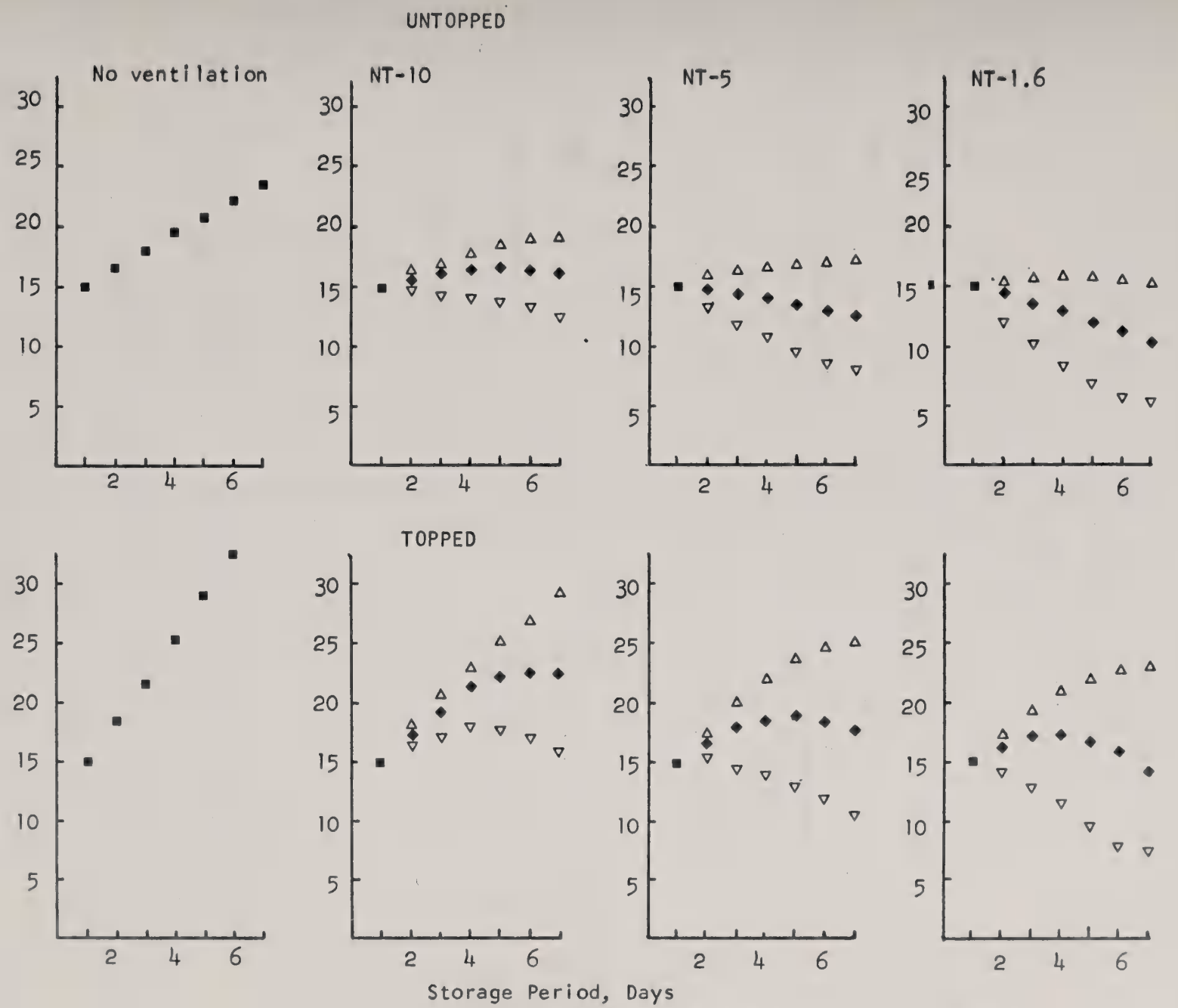
UNTOPPED
No ventilation
NT-10
NT-5
NT-1.6
TOPPED
30
25
20
15
10
5
2
4
6
Simulated Pile Temperatures °C
Storage Period, Days

Figure 2

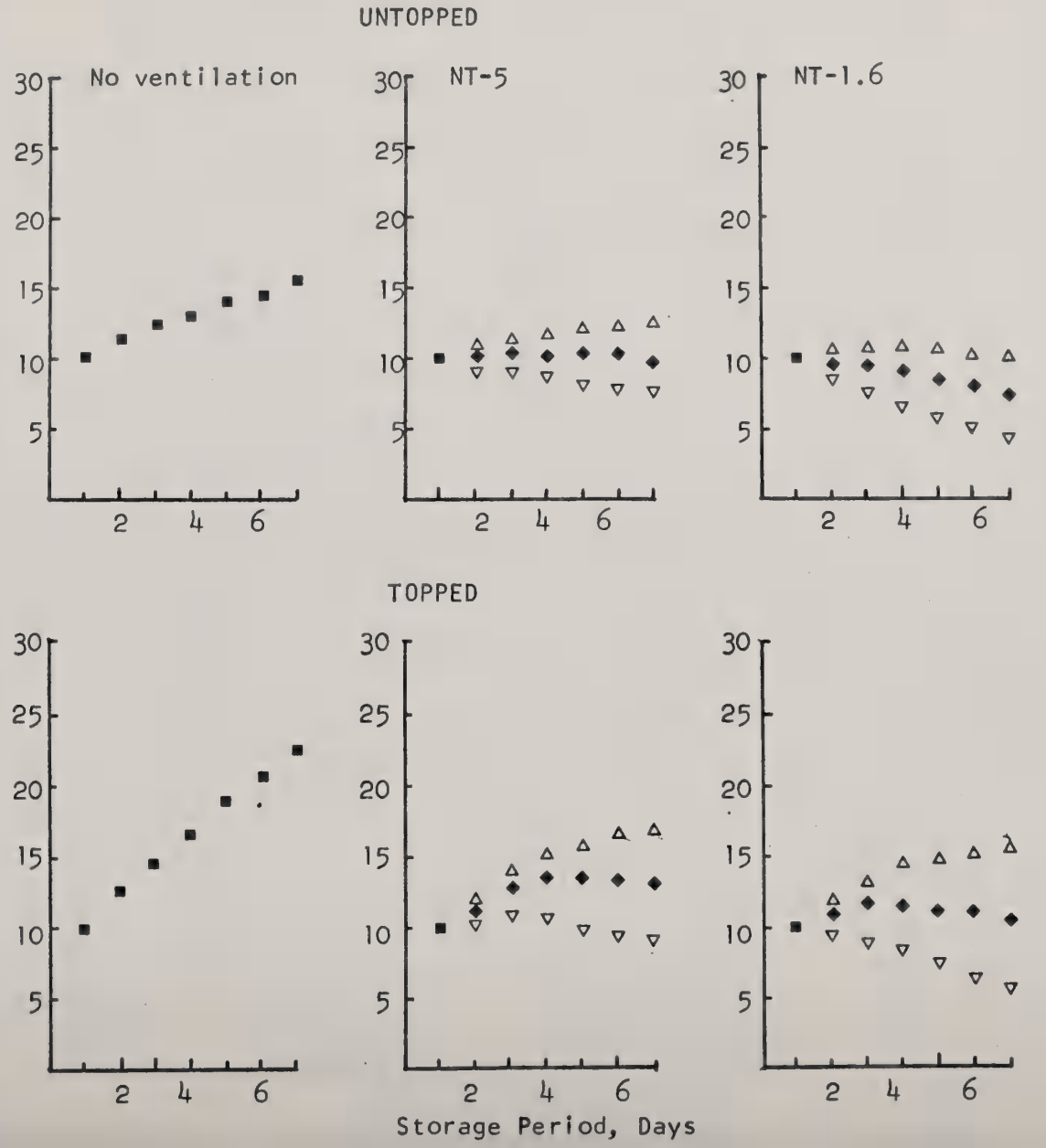
UNTOPPED
No ventilation
NT-5
NT-1.6
TOPPED
Simulated Pile Temperature, °C
Storage Period, Days
30
25
20
15
10
5
2
4
6

Figure 3

Table 2. Effect of topping, initial root temperatures, ventilation temperature and ventilation time on sucrose respired during the first week of storage in a covered pile.

Ventilation Time	Night Temperature					
	10C(50F)		5C(40F)		1.6C(35F	
	T*	U	T	U	T	U
hrs/day	lbs/Ton					
	Initial Root Temperature, 15C(60F)					
0	12.5	4.5				
6	10.1	4.1	9.2	3.8	8.7	3.6
12	7.8	3.7	7.6	3.3	7.0	3.1
24	7.3	3.3	6.1	2.9	5.4	2.5
	Initial Root Temperature, 10C(50F)					
0			6.7	2.9		
6			5.9	2.7	5.6	2.5
12			5.3	2.5	4.9	2.3
24			4.7	2.3	4.2	2.0

* T, Topped; U, untopped

Table 3. Effect of 24 hour refrigerated air cooling (1.6C, 35F) immediately after harvest on sucrose losses in topped roots during the first week of storage.

Ventilation Conditions	Non-Refrigerated	Refrigerated	Savings
	lbs/T/7 days		
	15C(60F) at harvest		
6/10 [1/]	7.7	10.0	2.3
24/10	6.6	7.3	0.7
	10C(50F) at harvest		
6/5	5.1	5.8	0.7
12/5	4.9	5.3	0.4

1/ Ventilation time/ventilation temperature - daily conditions for ventilation during the first week of storage.

Use of Fungicides to Reduce Deterioration of Sugarbeet Roots in Storage

David L. Mumford and Roger E. Wyse

The role of fungi in the millions of dollars lost annually from deterioration of sugarbeet roots after harvest has not been clear. In recent years much effort has gone into reducing losses by controlling storage environments. Considerable progress has been made including the recent practice of completely enclosing entire storage piles for environmental regulation. Observation of stored-roots thus enclosed suggests that fungus deterioration may be a more significant factor in present losses or at least deserves more consideration in the overall storage loss problem. With this in mind fungicides were evaluated in the laboratory and in controlled storage conditions to determine their ability to inhibit fungus deterioration of sugarbeet roots.

Evaluation of fungus growth inhibition on agar medium

An isolate of *Penicillium* and one of *Botrytis* were obtained from rotted beet roots taken from storage piles at Quincy, Washington. Based on preliminary tests four fungicides were selected from a group of ten evaluated to determine their ability to inhibit fungal growth on agar medium.

Methyl 1-(butylcarbamayl) -2- benzimidazolecarbamate (benomyl) 2-(4- thiazolyl) - benzimidazole (thiabendazole), pentachloro-nitrobenzene (PCNB), and sodium orthophenylphenate (SOPP) were compared more extensively using different concentrations of each.

The procedure for evaluating these fungicides consisted of placing a 2 mm fungus culture disk in the center of a petri plate containing 20 ml of 1% potato-dextrose-agar. Four sterile filter paper disks (6 mm dia) were positioned around the fungus disk an equal distance apart and 3 cm from it. After fungus growth began (ca 24 hrs), 0.01 ml of distilled water was added to one filter paper disk as a control and 0.01 ml of a selected concentration of a given fungicide was added to the other three paper disks. Fungus growth was allowed to progress until the mycelium had reached the control disk. Then the distance the colony had grown toward each filter-paper disk was measured. The average colony growth on six plates was determined for each fungus isolate and at each of three fungicide concentrations (100, 1,000, and 10,000 ppm). Results are based on inhibition of colony growth as a percent of the control.

As indicated in Table 1, benomyl and thiabendazole were quite effective in inhibiting growth of *Botrytis* and *Penicillium* on agar medium. Benomyl was the most effective fungicide tested at 100 ppm.

Evaluation of fungus growth inhibition on stored sugarbeet roots

Benomyl, thiabendazole, and PCNB were compared for ability to inhibit

fungus growth on stored sugarbeet roots. Washed roots harvested 2 months earlier and stored at 5° C were topped and immersed in a 1,000 ppm concentration of fungicide. After partial drying the roots were sprayed with an inoculum consisting of a mixture of Penicillium and Botrytis. The inoculum was prepared by very briefly blenderizing agar cultures of each fungus isolate then removing the agar by straining through cheesecloth. The resulting suspension of spores and hyphal fragments of the two fungi were mixed and applied as a spray to the root surface. Treated roots were stored in perforated plastic bags at 15° C.

After six weeks the roots were examined for fungus growth. Fungus growth was extensive on inoculated roots not treated with fungicide, particularly on the area injured during topping. Very little growth occurred on roots treated with PCNB or thiabendazole and no fungus growth occurred on roots treated with benomyl.

Effect of injury, washing, and healing in conjunction with fungicide application on fungus deterioration of stored roots

Based on experiments described above, benomyl was selected for further tests involving fungicide concentration and evaluating the role of injury, healing, and washing on deterioration of roots in storage.

Both washed and unwashed roots were used for injury treatments. Treatments of washed roots consisted of uninjured, injured, injured then washed a second time to remove juice caused by injury, and injured then sprayed with 15% sucrose after the second wash. Treatments of unwashed roots consisted of uninjured and injured. Imposed on each of the above treatments was the presence or absence of a spray application of fungus inoculum and presence or absence of a spray application of 1,000 ppm benomyl in all combinations. Five roots made up the sample for each treatment.

In all cases injury was inflicted by striking the root at a sharp angle with a rubber mallet. The resultant injury was approximately 0.5 cm deep and 3 X 4 cm in surface area.

After six weeks storage in perforated plastic bags at ca 15° C, the samples were examined visually for fungus deterioration and respiration rates were measured. Making an objective visual evaluation of fungus deterioration on individual roots was difficult. In general the results showed that injury was essential for the initiation of fungus growth and that a spray application of benomyl at 1,000 ppm gave complete control of both Penicillium and Botrytis. It was also evident that inoculation resulted in more deterioration on washed roots but had no effect on unwashed roots. No differences were observable due to washing roots after injury or sucrose application after the second wash.

Significant differences were present when root respiration was measured (Table 2). Differences in respiration reflect in a general way the differences in fungus development observed visually. No differences were present in benomyl treated roots. Where roots were not treated with benomyl respiration was higher in inoculated roots. Lowest respiration rates were in uninjured roots where fungus growth was not present. No attempt was made to separate respiration of the fungus and the root.

To test the effect of healing on fungus establishment, roots were injured then inoculated periodically after being allowed to heal from 1 to 10 days at 5° or 15° C. There was some indication that roots given an opportunity to heal before inoculation had less fungus growth than when there was no healing period. This was more pronounced with increased time of healing and when healing occurred at the higher temperature.

Three concentrations of benomyl were compared on roots that were injured and inoculated to determine the minimum concentration that would effectively control fungus growth. Concentrations of 1,000, 100, and 10 ppm were used. Visual observation of fungus growth after a six week storage period correlated very closely with respiration rates. Respiration rates in mg CO_2/kg/hr were as follows: Inoculated-0 benomyl, 15.1; 10 ppm, 9.7; 100 ppm, 8.0; 1,000 ppm, 5.5; not inoculated - 0 benomyl (control), 5.1. The LSD (.05) for this test was 2.07. No fungus growth was evident in the control and 1,000 ppm benomyl treatments. The optimum concentration of benomyl under these conditions was between 100 and 1,000 ppm.

Conclusions

There is probably an abundance of fungus inoculum on unwashed sugarbeet roots to initiate serious deterioration problems when conditions are favorable in storage. Root injury just before storage is probably the most significant factor in the extent of fungus deterioration that occurs. A spray application of benomyl at a concentration between 100 and 1,000 ppm will greatly reduce fungus deterioration by Penicillium and Botrytis of stored sugarbeet roots. There is usually not a sufficient time period between occurrence of root injury and storage for healing to be a significant factor in reducing deterioration.

Table 1. Inhibition of fungus growth on agar medium by four fungicides

Fungus	Fungicide	Inhibition in percent of control for each concentration 100 ppm*	1,000 ppm	10,000 ppm
Botrytis	Benomyl	44	51	56
	Thiabendazole	27	54	57
	SOPP	0	23	54
	PCNB	13	18	26
Pencillium	Benomyl	21	31	49
	Thiabendazole	0	27	41
	SOPP	0	14	33
	PCNB	0	7	9

* Concentrations were adjusted to comparable amounts of active ingredient for each fungicide.

Table 2. Effect on respiration of fungus deterioration of sugarbeet roots.

Treatment	Respiration Rate: Inoculated or benomyl treated -I-B	+I-B	-I+B	+I+B	Mean
	Mg CO_2/kg/hr				
Washed - uninjured	5.1				
- injured	8.1	11.7	5.6	13.0*	8.5
- injured + 2nd Wash	9.0	13.7	7.7	7.1	9.4
- injured + 2nd Wash + sucrose	9.4	17.1	7.7	9.5	10.9
Unwashed - uninjured	6.7	7.5	7.7	5.9	7.0
injured	15.4	12.2	7.3	6.7	10.4
Mean	9.7	12.4	7.2	7.3	

LSD (.05) 2.07

* This treatment contained a root with severe bacterial rot and is not included in computation of means.

SUGARBEET RESEARCH

1974 Report

Section C

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Cooperation:

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CONTENTS

PAPERS PUBLISHED OR ABSTRACTS OF PAPERS APPROVED FOR PUBLICATION, 1974

HECKER, R. J. and E. G. RUPPEL. Inheritance of resistance to Rhizoctonia root rot in sugarbeet. Approved by ARS for publication in Crop Science.

Segregating populations from crosses of rhizoctonia-susceptible and-resistant strains of sugarbeet (*Beta vulgaris* L.) were studied for 3 years to determine the inheritance of resistance to root rot caused by *Rhizoctonia solani* Kuehn. Broad sense heritabilities were increased by intensity of infection and ranged from 0.07 to 0.65 in the F_2's. The degree of infection in inoculated field experiments was continuous, but was rated into eight disease index classes for purposes of measurement. Groupings into discrete classes such as susceptible, intermediate, or resistant were not possible. The partitioning method of genetic analysis was used to study the genetic control of resistance. A somewhat different genetic model was determined to be most descriptive in each of the 3 years. The majority of the variation in the segregating populations could not be assigned to one gene, but two genes did account for most of the variation. All three models involved two loci and two or three alleles. We concluded: (a) Two loci accounted for the majority of the expression of resistance. (b) Resistance was partially dominant at the major loci in all but one instance. (c) Year X genotype interactions affected resistance, but their magnitude was not practically important. (d) There was evidence that the two resistant parents did not have exactly the same genotypes for resistance. (e) Epistatic interactions appeared to affect resistance. (f) Minor or modifying genes probably were involved in resistance.

HECKER, R. J. and J. O. GASKILL. Plastic isolation chambers for sugarbeet seed production. Approved by ARS for publication in J. Amer. Soc. Sugarbeet Technol.

This report describes a relatively inexpensive isolation chamber for flowering plants that prevents pollination from outside sources. The equipment was designed for sugarbeet research needs, but could be used for or adapted to any flowering plants that need isolation from foreign pollen. A blower-filter unit of our own design supplies a continuous flow of pollen-free air into the chamber. The blower-filter unit is illustrated in detailed photographs and drawings so that others may fabricate similar equipment. The isolation chambers can be used outside in summer in temperate climates or year-round in controlled-temperature greenhouses. Such chambers in the greenhouse allow the production of three sugarbeet seed crops per year.

HECKER, R. J. and G. A. SMITH. Tests of granular ethephon as a male gametocide on sugarbeet. Approved by ARS for publication in Canadian J. Plant Sci.

On the basis of our previous experiments and the findings of research on other plant species, it appeared that ethephon [(2-chloroethyl)phosphonic

acid] had some promise as a male gametocide. We tested, by soil incorporation, various rates of granular ethephon on sugarbeet at different stages of development. The chemical induced some male sterility but not enough to be of practical value. In addition, the chemical was very phytotoxic. Ethephon seemed of little or no value as a male gametocide on sugarbeet.

MAAG, G. W., R. J. HECKER, and P. A. WHITAKER. Nitrogenous compounds in sugarbeet juices. J. Amer. Soc. Sugar Beet Technol. 17: 154-164. 1972.

Juices from sugarbeets (*Beta vulgaris* L.), grown at three nitrogen (N) fertility levels, were analyzed for individual N constituents. Over 93% of the total N was identified in twenty-one amino acids, two amides, betaine, ammonia, and nitrates. The amino N in the amino acids and amides accounted for about 33% of the total N; glutamic acid and glutamine contained about 63% of the amino N. Up to 36% of the total N was found in betaine, a nitrogenous base. The total N and amino N showed a significant increase with each N fertility increase. Betaine N did not increase significantly because of N fertility treatments; ammonium and nitrate N each showed a significant difference between the low and high N treatments only.

MAAG, G. W. and G. H. SISLER. False polarization: Quantitation and characterization in sugarbeet processing juices. Approved by ARS for publication in J. Amer. Soc. Sugar Beet Technol.

In nine samples of five sugarbeet factory processing juices, the polarimetric sucrose readings consistently were higher than the corresponding GLC readings, but the differences were significant only in standard liquor and molasses samples. Glucose decreased quantitatively during processing, but its dextrorotary effect overcame most of the levorotary effect of the 20 measured amino acids, two amides, and the hydrolyzed product of glutamine, pyrrolidone carboxylic acid, some of which have dextro and some levo specific rotation. Results indicate that other dextrorotary compounds in the samples, besides those measured, cause the significantly higher pol sucrose readings in the standard liquor and molasses.

RUPPEL, E. G. Factors affecting conidial dimensions of a Drechslera species. Mycologia 66: 803-807. 1974.

Growth medium, culture age, and temperature, but not mounting medium, affected the size of conidia of the *Drechslera* state of *Cochliobolus spicifer*. Larger conidia were produced on oatmeal and potato dextrose agars than on corn meal, Czapek's, and malt extract agars. Conidia produced at 15 C were larger than those produced at 28 C, and those from 7-day-old cultures were larger than those from the same cultures 14 days old. Conidia produced on living or dead tissue of *Bouteloua gracilis* were larger than those from potato dextrose agar. Light had no effect on conidial size. Results demonstrate the importance of using standardized cultural conditions in comparative studies of fungal species.

RUPPEL, E. G. and P. R. SCOTT. Strains of Cercospora beticola resistant to benomyl in the U.S.A. Plant Dis. Reptr. 58: 434-436. 1974.

Cercospora beticola isolates from six benomyl-sprayed sugarbeet fields in northern Texas showed in vitro resistance to benomyl. Texas, Colorado, and Maryland isolates from fields having no history of benomyl application were benomyl sensitive. Growth rates in culture did not reveal differences in vigor between benomyl-resistant or sensitive isolates. Attempts to induce benomyl resistance by growing sensitive isolates on increasing amounts of benomyl in vitro were unsuccessful.

RUPPEL, E. G. Biology and toxicology of benomyl-tolerant strains of Cercospora beticola from sugar beet. Approved by ARS for publication in Phytopathology.

Benomyl-tolerant strains of *Cercospora beticola* as a group were no different from benomyl-sensitive strains in growth and sporulation in vitro or in virulence and sporulation in vivo. Strains differed in their degree of tolerance, the tolerance level being stable for at least 1 yr in vitro. Tolerance of one strain was unchanged after three passages through sugar beet. In mixed inoculations of sugar beet with a sensitive strain, a tolerant strain population declined, but never disappeared. Degree of cross-tolerance as measured by linear growth of three tolerant strains tested against benomyl, thiabendazole, and thiophanate depended on isolate, fungicide, and fungicide concn. Conidial germination of a tolerant and a sensitive strain tested against three benzimidazole derivatives and six protectant fungicides showed that the sensitive strain generally was more sensitive to all the fungicides at concns of 10 µg or more per ml, and the protectants were somewhat more inhibitory to both strains than were the systemics. Benomyl was more toxic to conidia than hyphae of a tolerant strain, whereas the reverse was true for thiabendazole. Conidial production of three tolerant strains was reduced on benomyl-amended medium; the degree of reduction depended on the isolate and benomyl concn. Viability of conidia produced on media with 0.1 or 10 µg benomyl/ml was reduced, but 1 µg/ml appeared to be stimulatory. Ultraviolet irradiation of conidia from a sensitive strain failed to induce benomyl-tolerant mutants.

RUPPEL, E. G. A cultural variant of a benomyl-tolerant strain of Cercospora beticola. Approved by ARS for publication in Phytopathology.

A white variant (H1-12/W) developed from a benomyl-tolerant strain (H1-12) of *Cercospora beticola* after transfer of the parent strain to potato-dextrose agar containing 100 µg a.i. benomyl/ml. The variant was stable through repeated subculturing and in passage through sugar beet. Benomyl tolerance of H1-12/W was similar to that of H1-12; however, the latter sporulated more prolifically in vitro and in vivo than the variant. H1-12/W was only slightly less virulent than H1-12 in sugarbeet, but the incubation period for lesion formation was almost twice as long for H1-12/W as for H1-12. Reisolations from sugar beet infected with H1-12/W yielded cultures identical to H1-12/W, with no reversions to the parental strain.

RUPPEL, E. G., F. J. HILLS, and D. L. MUMFORD. Epidemiological observations on the sugarbeet powdery mildew epiphytotic in western U.S.A. in 1974. Approved by ARS for publication in Plant Dis. Reptr.

Powdery mildew on sugarbeet occurred in epiphytotic proportions in Arizona, California, Colorado, Idaho, Kansas, Montana, Nebraska, New Mexico, Oregon, Texas, Utah, Washington, and Wyoming in 1974. A south to north, west to east sequential occurrence of the disease was noted from March to September after the first incidence in the Imperial Valley of California. Mildew attacks ranged from mild to severe, with estimated losses of 0 to 6.8 m tons/ha in root yield and 0 to 1.5% in sucrose concentration. Less severe infection occurred in fields under sprinkler irrigation.

Two applications of sulfur dust at 22 to 45 kg/ha, or one application of wettable sulfur at 11.3 kg in 142 liters water/ha gave good control of powdery mildew. Benomyl, generally, was not effective at the maximum allowable rates. Federal registration of chemicals for sugarbeet powdery mildew control is being sought. Some differences in susceptibility were reported among and within sugarbeet cultivars.

The pattern of spread of the disease suggests that conidia were disseminated from southern and western warm regions to subsequent crops planted in the northerly and easterly areas. The onset of mildew also seemed to be associated with plant age and usually did not develop until $2\frac{1}{2}$ to 6 months after planting. A new virulent race, or a newly introduced race of *Erysiphe polygoni* (or *E. betae*) may explain the sudden outbreak of sugarbeet powdery mildew in the U.S.A.

SMITH, G. A. and E. G. RUPPEL. Heritability of resistance to Cercospora leaf spot in sugarbeet. Crop Sci. 14:113-115. 1974.

Narrow sense heritability estimates adjusted to account for inbreeding of parental lines were compared with realized heritabilities obtained by actual selection for high and low resistance to *Cercospora beticola* in sugarbeet (*Beta vulgaris*). Parental, F_1, F_2, F_3, and polycross populations from high and low selections were field grown under an artificially induced leaf spot epidemic. Heritability estimates in %, were 24.3±2.9 and 24.3±2.4 for each of two resistant X susceptible crosses. These values were compared with realized heritabilities of 20.47% and 26.71% for the same two resistant X susceptible crosses. Environmental variation accounted for 44 to 62% of the total variation for leaf spot resistance.

SMITH, G. A. and R. J. HECKER. Components of yield of recoverable sugar in random and improved sugarbeet populations. Can. J. Plant Sci. 53: 665-670. 1973.

Path coefficient analyses indicated that selection and other breeding procedures alter the relative importance of characters that determine recoverable sugar yield in sugarbeet.

Root weight was a more important yield component than sucrose percentage and over twice as important as purity in an unselected population.

Root weight and sucrose percentage contributed about equally in improved populations, but the importance of both to recoverable sugar was substantially greater than in the unselected population. Purity was about twice as important a component in the improved population as it was in the unselected population. Results suggest that the emphasis of breeding programs will need to change with changes in the genetic structure of the improved population.

Because of the lack of negative indirect effects in the commercial population, the association of recoverable sugar and sucrose % was nearly twice as high as compared to the relatively unimproved random hybrid population.

SMITH, G. A., R. J. HECKER, G. W. MAAG, and D. M. RASMUSON. Combining ability and gene action estimates in an eight parent diallel cross of sugarbeet. Crop Sci. 13: 312-316. 1973.

Twenty-eight F_1 hybrids from an 8 parent diallel cross grown at two nitrogen fertility levels were analyzed for type of gene action controlling eleven sugarbeet (*Beta vulgaris* L.) characters. Nonadditive genetic variance was of prime importance in controlling root weight under low and high nitrogen levels, accounting for 51% and 68% of the total genetic variance, respectively. For recoverable sugar, nonadditive genetic variance accounted for 67% and 83% of the total genetic variance under low and high nitrogen. Additive genetic variance accounted for most of the genetic variance for sucrose percentage and root/shoot ratio. Both additive and nonadditive genetic variance were significant for thin juice purity %, but only at the high nitrogen fertility level.

Additive genetic variance was predominant for six nonsucrose components of purified juice. In addition, significant amounts of nonadditive gene action were found for all six nonsucrose components at one or both nitrogen levels. Betaine was the least affected by change in nitrogen of all the characters measured.

RHIZOCTONIA INVESTIGATIONS, 1974

Breeding

Rhizoctonia Resistance Breeding Research, 1974.--R. J. Hecker and E. G. Ruppel.--Experiments related to our program of breeding for rhizoctonia root rot resistance in sugarbeet were conducted primarily at our new disease nursery (Harmony tract) 1½ miles south of the Colorado State University Agronomy Research Center, Fort Collins, Colorado. This is our first year of experiments on this BSDF-leased farm where we will be conducting both our rhizoctonia and cercospora research. Our rhizoctonia root rot epidemic in 1974 was excellent (severe). Except for the selection areas which were rosette inoculated, the entire field was broadcast-inoculated with a tractor mounted Eze-Flo 'Gandy' 4-row applicator. The dry, ground barley-grain inoculum of *Rhizoctonia solani* (isolate R-9) was broadcast in a band over each row at a rate of 34 g per 20 ft of row, in a split application (17 g per 20 ft) with opposite directions of travel for each application. One-row plots 20 ft or 12 ft long and 22 inches apart were planted May 24. Thinning was completed July 10, and the inoculation was done July 25. The roots were lifted and individually rated for severity of root rot September 23-26. The disease index (DI) ratings were based on a scale of 0 to 7 (0 = no evidence of infection, 7 = dead). The percentage of healthy roots (ratings 0 and 1 combined) were also calculated. We consider the DI to be the best measure of resistance; however, percentage healthy roots does provide a better concept of the proportion of essentially healthy roots among the lines tested.

In our breeding program for rhizoctonia root rot resistance, we are using both recurrent selection and mass selection. Those breeding lines in which we have greatest interest or are desirous of improving most rapidly are in our recurrent selection program. In this program we make phenotypic selections for resistance following inoculation in the field or greenhouse. These selections are polycrossed and self-pollinated, or the mother plants are reverted to the vegetative condition (in the case of greenhouse selections). Progeny from each mother plant are then tested in the field or greenhouse. Superior progeny resistance dictates which selfed or reverted mother plants are then interpollinated to form a synthetic for commencement of the next recurrent selection cycle. The synthetic of each cycle is also used as a pollinator on a set of CMS single crosses. The resulting experimental hybrids are evaluated for root yield, sucrose, and quality. Evaluations of general and specific combining ability are also obtained from these tests.

Additional breeding lines are carried in our mass selection program. Breeding lines from each cycle of mass selection are also used

to pollinate the above mentioned set of CMS single crosses. At any time, certain lines may be deleted from the program or switched from recurrent to mass selection or vice versa.

Most of our breeding lines are multigerm and intended as potential pollinators. But we are also working with monogerm type 0, leaf spot-curly top resistant lines which could ultimately be used on the female side of hybrids. New lines we have introduced into our program include high sucrose lines, Russian accessions, European accessions, and SP 6822-0.

We have commenced a greenhouse mass selection for seedling resistance to *Rhizoctonia*. Our objective is to discover if improvement of seedling resistance to rhizoctonia damping-off can be made and to see if such resistance enhances resistance to rhizoctonia root and crown rot.

Our breeding lines are evaluated in the field each year for resistance. The 1974 evaluations are described in the following section.

Evaluation of Breeding Lines for Rhizoctonia Resistance.--R. J. Hecker and E. G. Ruppel.--Each year in our rhizoctonia resistance breeding program we evaluate for resistance our latest developments that are in the synthetic or pollinator phase. Various other lines are frequently evaluated in the same test. These evaluations for 1974 are listed below in Table 1.

Under severe infection in 1974, our most resistant lines were FC 701/5, FC 702/5, and FC 703/1. These are our lines which have had the most cycles of selection for resistance. Apparently, these lines still possess genetic variability for resistance. However, evidence from 1973 experiments indicated that the rate of improvement in the FC 701 and FC 702 series of lines may be declining. Inheritance studies completed in 1973, which indicated that two or more genes were responsible for the major portion of the genetic variability for resistance, lead us to believe that we should be able to further improve the resistance in the FC 701 and FC 702 lines. Our FC 703 lines have resulted from a recombination of the FC 701 and 702 lines. Hence, the FC 703 lines may offer the most promise for approaching complete resistance under the disease exposure in our inoculated tests.

Several other lines in Table 1 show considerable resistance, namely, entries 228, 229, 230, 231, and 232. Entries 234 and 258 are the best lines among those segregating for monogerm and type 0.

The six commercial hybrids and the other miscellaneous lines in Table 1 are all highly susceptible.

Experimental hybrids involving some of these breeding lines as pollinators were tested for root yield, sucrose, and purity in 1974. The results of these tests are described in the Breeding and Genetics section of this report.

Table 1. Rhizoctonia resistance evaluation of breeding lines for disease index and % healthy roots in 1974. Means within columns followed by the same letter are not significantly different (P = .05).

Entry no.	Population and description	D.I.	% healthy
	Multigerm Rhiz. breeding lines		
217	FC 701/5; 6 cy.Rhiz.sel.	2.18a	58a
218	FC 701/5; 7 cy.Rhiz.sel.	2.18a	55a
216	FC 701/4; 6 cy.Rhiz.sel.	2.57abcd	48abcd
254	FC 701/4; increase of entry 216	2.93abcd	40abcde
222	FC 702/5; 7 cy.Rhiz.sel.	2.38abcd	55a
221	FC 702/5; 6 cy.Rhiz.sel.	3.10bcd	43abcd
255	FC 702/4; 6 cy.Rhiz.sel.	3.28cd	31cde
225	FC 703; 7 cy.Rhiz.sel.	2.68abcd	45abcd
224	FC 703(sub-line); 7 cy.Rhiz.sel.	2.42abc	58a
256	FC 703; 5 cy.Rhiz.sel.	2.85abcd	40abcde
226	FC 703; 6 cy. field & 1 cy.GH Rhiz.sel.	3.40d	33bcde
223	FC 703/1; 6 cy.Rhiz.sel.	2.20a	59a
227	Rhiz.res.misc. sources; ±LSR	4.38e	12ghi
228	Pool of GW 674 & C 817 Rhiz.res.lines	2.40ab	45abcd
229	Increase of one progeny line from GW 674 & C 817	2.58abcd	43abcd
230	Increase of one progeny line from GW 674 & C 817	2.65abcd	40abcde
231	Increase of one progeny line from GW 674 & C 817	2.57abcd	49abc
232	Increase of one progeny line from GW 674 & C 817	2.57abcd	47abcd
233	2 cy.Rhiz.sel. from FC 901 X FC 702/3; ±LSR-CTR	3.38d	24efg
235	FC 801; ±LSR-CTR	3.40d	40abcde
236	FC 801 (sub-line)	5.13ef	12ghij
237	Synthetic of 5 Rhiz.res.sources	3.40d	29def
239	Synthetic of 5 superior progeny lines	3.37d	30cde
240	1 cy.Rhiz.sel. from FC 901 X FC 702/3; ±LSR-CTR	6.02hijkl	3ijklm
241	1 cy.Rhiz.sel. from FC 901 X FC 701/3; ±LSR-CTR	4.68ef	14fgh
	Rhiz. breeding lines with mm & type 0		
234	2 cy.Rhiz.sel.from FC 701Xmm,type 0,LSR-CTR lines	2.68abcd	53ab
242	Rhiz.sel.from LSR-CTR,mm,type 0 X FC 701; B_1P_1	4.50ef	23efg
249	Rhiz.sel.from LSR-CTR,mm,type 0 X FC 701; B_1P_1	4.32e	28def
258	Rhiz.sel.from FC 701 X LSR-CTR,mm,type 0; B_1P_1	2.67abcd	49abc
	Miscellaneous lines & hybrids		
214	GW 674; source of FC 701 series	5.85ghij	6hijkl
215	GW 674; increase of entry 214	6.02hijkl	2jklm
219	C 817; source of FC 702 series	6.12ijkl	5hijkl
220	C 817; increase of entry 219	6.15ijkl	0 lm
243	Mono Hy A1	5.93ghijk	6hijkl
244	Mono Hy D2	6.27ijkl	5hijkl
245	HH-21	6.43jkl	3ijklm
246	Amer. #2 Hyb.B	6.78kl	0 lm
247	US H20	6.58jkl	3ijklm
248	US H10B	6.82 l	0 lm
238	FC 901	6.70jkl	1 klm
250	SP 72547-0	5.27fgh	10ghij
251	SP 67547-01	5.92ghijk	7hijkl
252	SP 71550-0	5.55ghi	8hijk
253	SP 7322-0	6.42jkl	3ijklm
257	Rhiz.susc. check	6.70jkl	1 klm

Evaluation of Contributed Lines.--E. G. Ruppel and R. J. Hecker.--Eighty-six entries from Amalgamated, American Crystal, Holly, Great Western, Spreckels, and Utah-Idaho sugar companies were evaluated for resistance to *Rhizoctonia* in six experiments. Resistant controls were included in all tests. Results of each company's test were analyzed and sent to company breeders, thus, they will not be reproduced here. Generally, the resistant controls had significantly less rot than other entries, and hybrids with resistant parentage were more resistant than entries having no history of selection or breeding for rhizoctonia resistance.

Comparison of Rhizoctonia Resistance of Diploid (2n) and Equivalent Triploid (3n) Hybrids.--R. J. Hecker and E. G. Ruppel.--Limited experimental data in 1973 indicated that 3n hybrids, where the rhizoctonia resistant pollinator parent was tetraploid (4n), may be more resistant than equivalent 2n hybrids. However, no difference was noted between 2n and 4n equivalent resistant parents. More extensive data were gathered in 1974.

Previously, we had converted three of our rhizoctonia resistant breeding lines to the tetraploid (4n) condition, namely FC 701/4, FC 702/4, and FC 703. We now have these lines advanced to C_5 and have had no difficulty in maintaining them. We used these three lines as 2n and 4n pollinators on three, 2n CMS, single crosses (11866 CMS X 12163, GW-918, and H65-02-69) provided by American Crystal, Great Western, and Holly Sugar Companies, respectively. These CMS single crosses are currently being used in commercial hybrid varieties. This provided the set of 18 hybrids which we compared in 1974 for rhizoctonia resistance.

Table 1 lists the DI and % healthy plants for each hybrid and pollinator parent as well as certain group means. All pairs of 2n and 3n means were tested for significant differences. Five of the nine 2n hybrid vs. 3n hybrid comparisons showed that the 3n hybrid had a significantly lower disease index. The three 2n and 3n means of groups with common female parents all showed that the 3n hybrids had a significantly lower disease index, as did the mean of all nine 3n hybrids compared to the 2n hybrids. Comparison of the 2n and 4n pollinators showed no significant differences.

In Table 2, the effect of female parent on resistance is demonstrated. It is apparent from these data that the female parent H65-02-69 imparts greater resistance to hybrids than 11866 CMS X 12163 and possibly slightly more than GW-918. GW-918 hybrids were significantly more resistant than 11866 CMS X 12163 hybrids. Although the female parents were not included in 1974, 1973 data on these three female lines are included in Table 1. In 1973, the rank of these three female parents was the same as the 1974 hybrids, with H65-02-69 significantly more resistant than 11866 CMS X 12163. It should be noted that the infection in 1974 was much more intense than in 1973.

Table 1. Disease index and percentage healthy roots of hybrids and parents at different ploidy levels.

Entry no.	Hybrid, parent, or group	Ploidy level	DI	% healthy
	1974			
262	(11866 CMS X 12163) X FC 701/4	2n	4.50	19.0
263	(11866 CMS X 12163) X FC 701/4 (4n)	3n	4.34	9.8
270	(11866 CMS X 12163) X FC 702/4	2n	4.86 }*	10.5
271	(11866 CMS X 12163) X FC 702/4 (4n)	3n	3.54 }*	22.2
278	(11866 CMS X 12163) X FC 703	2n	5.10 }**	5.9
279	(11866 CMS X 12163) X FC 703 (4n)	3n	3.72 }**	16.2
	Mean of three 2n hybrids	2n	4.82 }**	11.8
	Mean of three 3n hybrids	3n	3.87 }**	16.1
264	GW-918 X FC 701/4	2n	4.46 }**	12.4 }**
265	GW-918 X FC 701/4 (4n)	3n	2.40 }**	57.2 }**
272	GW-918 X FC 702/4	2n	4.10	17.5
273	GW-918 X FC 702/4 (4n)	3n	3.72	15.4
280	GW-918 X FC 703	2n	3.72 }*	25.4
281	GW-918 X FC 703 (4n)	3n	2.72 }*	33.8
	Mean of three 2n hybrids	2n	4.09 }**	18.4 }**
	Mean of three 3n hybrids	3n	2.95 }**	35.5 }**
266	H65-02-69 X FC 701/4	2n	3.62 }**	22.0 }**
267	H65-02-69 X FC 701/4 (4n)	3n	1.22 }**	88.0 }**
274	H65-02-69 X FC 702/4	2n	4.16	13.5
275	H65-02-69 X FC 702/4 (4n)	3n	4.40	15.1
282	H65-02-69 X FC 703	2n	3.64	19.6
283	H65-02-69 X FC 703 (4n)	3n	3.08	29.5
	Mean of three 2n hybrids	2n	3.81 }**	18.4 }**
	Mean of three 3n hybrids	3n	2.90 }**	44.2 }**
	Mean of nine 2n hybrids	2n	4.24 }**	16.2 }**
	Mean of nine 3n hybrids	3n	3.24 }**	31.9 }**
259	FC 701/4; 6 cycles Rhiz.sel.,(source of 4n)	2n	2.40	53.2
261	FC 701/4, (increase of source of 4n)	2n	2.46	50.5
260	FC 701/4 (4n), C_3	4n	1.66	53.9
286	FC 701/4 (4n), C_5	4n	2.30	49.0
268	FC 702/4; 6 cycles Rhiz.sel.,(source of 4n)	2n	2.90	32.0
269	FC 702/4 (4n) C_3	4n	3.04	31.6
276	FC 703; 5 cycles Rhiz.sel.,(source of 4n)	2n	2.44	39.7
277	FC 703 (4n), C_3	4n	2.70	34.8
	Mean of four 2n pollinators	2n	2.55	43.8
	Mean of four 4n pollinators	4n	2.43	42.3
	1973			
	11866 CMS X 12163		3.73	20.1 }* }*
	GW-918		3.15 }*	34.9 }*
	H65-02-69		3.00	32.8

* or ** denotes a significant difference (.05 or .01) between connected means.

These data, along with the 1973 data, demonstrate rather conclusively that there is a dosage effect for rhizoctonia resistance. A triploid with two genomes carrying genes for resistance combined with one genome carrying genes for susceptibility is more resistant than a diploid with resistance in one genome and susceptibility in the other genome. Yet, autotetraploids of resistant lines are no more resistant than the diploids. Apparently, the quantity or quality of enzymes which ultimately effect resistance is different in the 3n and 2n hybrids. The susceptible characteristic of the susceptible parent is still apparent in the triploid hybrids, since these hybrids are not as resistant as the resistant parents themselves. Partial dominance for resistance has been demonstrated in our previous experiments with diploid hybrids. The extra resistant genome in the triploid hybrids further reduces the affect of the susceptible genome, but it does not achieve the equivalent of complete dominance. The absence of reciprocal effects (Sugarbeet Research, 1973 Report) for resistance indicates that resistance could be carried into hybrids through the female or the pollinator. However, resistance in the pollinator would be most practical.

From our previous experiments, which have rather consistently shown partial dominance for resistance, we feel that resistance in only the pollinator of a hybrid may be adequate to prevent significant losses to rhizoctonia root rot from natural infection. Based on the data reported here, we would expect that a resistant tetraploid pollinator would make resulting hybrids even more resistant. Whether or not we have adequate resistance in our most resistant breeding lines to achieve effective control in the field is questionable, since we have no way of comparing the intensity of exposure and infection in our inoculated nursery with field infections. Only exposure of experimental hybrids to natural infection can answer this question.

Table 2. Means of hybrids of the three female parents for disease index and percentage healthy.

Hybrid group	2n hybrids		3n hybrids		Mean	
	DI	% healthy	DI	% healthy	DI	% healthy
H866 CMS X 12163 hybs.	4.82	11.8	3.87	16.1	4.35	13.9
GW-918 hybs.	4.09	18.4	2.95	35.5	3.52	26.9
H65-02-69 hybs.	3.81	18.4	2.90	44.2	3.36	31.3

* or ** denotes a significant difference (.05 or .01) between connected means.

Pathology

Host Range of Three Rhizoctonia solani Isolates.--E. G. Ruppel.--A crown (CR-5), foliar (FR-6), and root (RR-9) isolate were tested for their potential to incite damping-off in several plant species. Results are presented in the following table:

Species	Mean % damping-off by isolate		
	CR-5	FR-6	RR-9
Alfalfa	75	64	0
Corn	16	38	99
Barley	11	18	99
Wheat	3	12	75
Bean	28	17	99
Sorghum	38	0	43
Pigweed	73	55	25
Muskmelon	89	63	45
Soybean	81	87	95
Red beet	91	84	96
Sugarbeet	81	66	79

Obviously, several crops used in rotation with sugarbeet in Colorado are highly susceptible in the seedling stage to one or more of the isolates. Since *Rhizoctonia* seldom is a serious problem in many of these crops, early planting when soil temperatures are low possibly aids in their escape from infection. Latent infections in mature plants, if they exist, might serve toward inoculum buildup in the field. This possibility will be investigated.

Growth of Rhizoctonia solani on Five Sugars.--E. G. Ruppel.--Total radial growth (mm) and growth rate (mm/hr) on solid media, and mycelial dry weight (mg) in broth media of isolates FR-6 (foliar) and RR-9 (root) were measured. Five sugars (all adjusted to 10 g C/liter) were added to Czapek's Solution Agar and Czapek's Dox Broth. Results are given in the following table (means of five replications followed by the same letter are not significantly different):

Isolate	Sugar	Growth		
		Radial	Rate	Dry wt
FR-6	Fructose	67 c	1.8 a	127 abc
	Glucose	54 d	1.4 b	236 a
	Galactose	72 a	1.9 a	63 bc
	Sucrose	71 ab	1.9 a	161 ab
	Raffinose	69 bc	1.9 a	92 bc
RR-9	Fructose	28 f	0.6 b	25 c
	Glucose	23 g	0.5 b	19 c
	Galactose	33 e	0.7 b	15 c
	Sucrose	26 f	0.6 b	21 c
	Raffinose	27 f	0.6 b	17 c

Maximum growth on solid media did not necessarily correspond to maximum growth in broth. Galactose was one of the better carbon sources for both isolates on solid media, but more mycelial dry weight occurred in broth with glucose than with galactose.

Effect of Temperature on Damping-off by Rhizoctonia solani.--E. G. Ruppel.--Sugarbeet seed of five cultivars were planted in *Rhizoctonia*-inoculated soil and in noninoculated soil (control). All pots of soil were equilabrated at the test temperature before planting. Seedling emergence at 14 days was recorded for 16, 20, 24, and 28 C. Actual results are given in the following table; statistical analyses were performed on transformed data (Bliss 1937).

Line	Damping-off as % of control at temp of			
	16 C	20 C	24 C	28 C
FC 701/5	72	83	83	88
GW 674-56C	88	91	64	97
FC 901	71	74	72	90
GWH 52-71R	72	100	73	84
GWH 45-70R	89	95	76	87

There were no significant differences among lines at any temperature. Generally, there was more damping-off at 20 C than at the other temperatures.

Effect of Some Naturally-Occurring Compounds on Growth of Rhizoctonia solani (R-9) in Vitro.--E. G. Ruppel.--Betaine·HCl, cinnamic acid, esculin hydrate, quercetin, and scopoletin were added to potato dextrose agar at 0, 0.1, 1.0, 10.0, and 100.0 µg/ml to test their effect on growth of *R. solani*. Only cinnamic acid and scopoletin at 100 µg/ml caused a slight, but nonsignificant, inhibition of radial growth.

Effect of Growth Duration of Rhizoctonia on Barley-grain on Subsequent Root Rot Severity.--E. G. Ruppel.--Isolate R-9 was grown on moist barley grain for 2, 4, and 6 weeks before the inoculum was dried and ground. Tests on a selective medium indicated 1000 propagules/g for 2-week inoculum, 1130 for 4-week inoculum, and 310 for 6-week inoculum. In the greenhouse, mean disease indexes (D.I. = 0 to 5, with 0 = healthy) for rhizoctonia-resistant FC 701/5 were 2.8, 2.3, and 0 for 2-, 4-, and 6-week inoculum, respectively. Mean D.I.'s for susceptible FC 901 were 5, 4.3, and 0.3 for 2-, 4-, and 6-week inoculum, respectively. In the field, D.I.'s (0 to 7) for FC 901 were 6.9, 5.5, and 2.5 for 2-, 4-, and 6-week inoculum, respectively.

CERCOSPORA INVESTIGATIONS, 1974

1974 Leaf Spot Evaluation of Submitted Company Lines.--G. A. Smith and E. G. Ruppel.--The 1974 leaf spot epidemic which developed at Fort Collins was rather mild. It was characterized by a very late build-up and never did manifest itself as well as in previous years. Consequently, we plan on establishing our Cercospora nursery a little earlier next year and also modifying our schedule for overhead sprinkling. We were able to obtain two leaf spot readings in spite of a less than desired epidemic. This year we evaluated 155 lines which were submitted by four sugar companies. Results of those tests were sent to each respective company.

Pathology

Seed Treatment with Cultural Extract of Cercospora beticola.--E. G. Ruppel.--Subsequent disease severity in inoculated rice plants grown from seed soaked in a cultural extract of the pathogen (*Helmintho-sporium*) was reported to be significantly reduced. Sugarbeet seed of cvs. US 201 and R & G Pioneer were soaked for 24 hr in a sonicated cell-free cultural extract of *C. beticola*. Control seed were soaked

in an extract from noninoculated medium. The seed was then dried and planted. The seedlings were inoculated with a spore suspension of *C. beticola* 3 weeks after planting. Disease severity was not significantly affected by the treatment.

Effect of Some Naturally Occurring Compounds on Growth of Cercospora beticola in Vitro.--E. G. Ruppel.--Betaine·HCl, cinnamic acid, esculin hydrate, quercetin, and scopoletin in potato dextrose agar at 0, 0.1, 1.0, 10.0, and 100 µg/ml were tested for their effect on growth of *C. beticola*. Cinnamic acid, esculin hydrate, quercetin, and scopoletin at 100 µg/ml were only slightly inhibitory. Results of this test were not believed to be biologically significant.

Lesion Type Induced by Several Cercospora Isolates.--E. G. Ruppel.--Four Colorado, 1 Maryland, 1 Michigan, and 2 Texas isolates of *C beticola* were inoculated to 2-month-old plants of cvs. US 201 and FC 701/2. All isolates induced typical leaf spots. No "fleck" reaction, as reported for some California isolates, was noted.

Effect of Mist Duration on Subsequent Leaf Spot Severity.--E. G. Ruppel.--Infection of sugarbeet by *Cercospora beticola* in greenhouse tests is facilitated by post inoculation treatment of 100% relative humidity in a mist-chamber. Cultivars R & G Pioneer (highly susceptible), SP 6322-0 (moderately resistant), and FC(504 X 502/2) X SP 6322-0 (highly resistant) were inoculated with *C. beticola* and held in a mist-chamber for 24, 48, and 96 hr. Disease severity in all cultivars increased with an increase in postinoculation mist duration. Mean disease indexes (0 to 5, with 0 = healthy) at 21 days after inoculation were 1.9 for the 24-hr duration, 2.8 for 48-hr, and 3.7 for the 96-hr treatment regardless of cultivar. There was no difference in disease severity between the moderately and highly resistant cultivars, but both showed slightly less disease than the susceptible Pioneer.

Effect of Sap Extracts on Germination of Cercospora Spores.--E. G. Ruppel.--Clarified, diluted sap extracts of cvs. Pioneer (highly susceptible), SP 6322-0 (moderately resistant), and FC(504 X 502/2) X SP 6322-0 (highly resistant) were mixed with spore suspensions of *C. beticola* to yield final sap concns (v/v) of 1:8, 1:16, 1:32, 1:64, and 1:128. After a 6-hr incubation at room temp, the spores were killed with lactophenol and percentage germination was determined with the aid of a microscope. Germination ranged from 89 to 96% in all treatments. There were no significant differences among lines (sap extracts) or dilutions. Thus, the sap extracts at the dilutions tested had no effect on spore germination.

MISCELLANEOUS DISEASE INVESTIGATIONS, 1974

Bacterial Vascular Necrosis in Washington.--E. G. Ruppel.--Beets from Moses Lake, Washington, exhibited typical symptoms of bacterial vascular necrosis and soft rot (Sugarbeet Research, 1972 Report, p. B64). A bacterium was isolated which proved to be pathogenic on sugarbeet. Disease symptoms were reproduced in inoculated beets and the same bacterium was reisolated. This disease previously has only been reported from California.

Identification of the Bacterial Agent Causing Vascular Necrosis and Soft Rot of Sugarbeet.--E. G. Ruppel.--Tests described by Graham (Graham, D.C. 1972. Identification of soft rot coliform bacteria, Pages 273-279 *in* H.P. Maas Geesteranus, ed. Proc. Third Int. Conf. on Plant Pathogenic Bacteria. Centre for Ag. Pub. and Doc., PUDOC, Wageningen, The Netherlands) were used to characterize the pathogen. Production of acid from lactose, maltose, trehalose, and α methyl-glucoside, growth in 5% NaCl, production of reducing substances from sucrose, resistance to erythromycin, negative indole and phosphatase tests, positive glucose fermentation, and pectolytic enzyme production indicated that the bacterium is *Erwinia carotovora* var. *atroseptica*. Pathogenicity tests on sugarbeet were conducted by inoculating beets with the Washington isolate WE-1, a sugarbeet isolate from California (UR-7 supplied by Sherman Thomson, Univ. Calif.), an isolate of *E. c.* var. *atroseptica* (NCPPB #549 from Monty Harrison, CSU), and *E. c.* var. *carotovora* (NCPPB #438 from Monty Harrison, CSU). Only the isolates from sugarbeet were pathogenic to sugarbeet. Thus, with the presently accepted classification scheme of soft-rot bacteria as given in the new Bergey Manual, the sugarbeet pathogen must be considered a strain or race of *Erwinia carotovora* var. *atroseptica*, which is the incitant of potato blackleg. Inoculations of potato will be conducted to determine if the sugarbeet isolates can induce blackleg symptoms.

Sugarbeet Powdery Mildew Epiphytotic in 1974.--E. G. Ruppel, F. J. Hills, and D. L. Mumford.--Questionnaires answered by agricultural personnel of the Beet Sugar Development member companies and personal observations were used to document the incidence, severity, and spread of powdery mildew in sugarbeet in the U.S.A. in 1974. A paper has been approved for publication (see abstract this report). Figure 1 illustrates the occurrence and south to north, east to west sequential spread of the disease in 1974. Epidemiological investigations on the disease have been initiated.

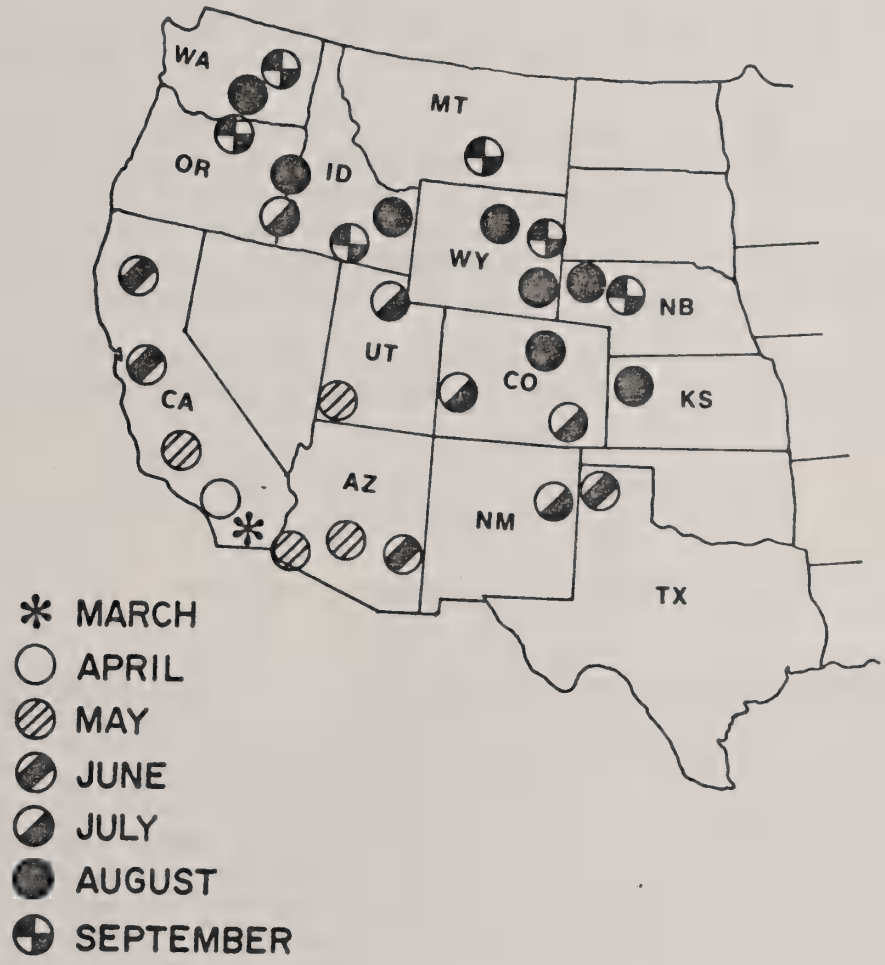

Figure 1
Sequence of powdery mildew occurrence on sugarbeet in western United States in 1974. General areas of sugarbeet production are indicated rather than individual fields since the epiphytotic was widespread.

Storage Rot of Sugarbeets as Influenced by Nitrogen Fertility and *Cercospora* Leaf Spot (Preliminary Progress Report).--G. A. Smith and E. G. Ruppel.--In 1974, we initiated a study to determine the effect of nitrogen fertility on leaf spot and of nitrogen fertility and leaf spot incidence on subsequent storability of harvested roots.

We grew three varieties with differing leaf spot susceptibilities at two nitrogen fertility levels under field leaf spot conditions. Plants were rated for degree of leaf spot, and then roots were harvested and analyzed for root weight, sucrose, purity, reducing sugars, Na, K, amino N, NO_3N, total N, conductivity ash, chloride, and betaine.

After roots were rasped for the above analyses, each root was inoculated with a mixed culture of *Phomae betae* and *Botrytis cinerea*. Roots were then placed in storage at 5.5 C and rot ratings taken at appropriate intervals. After 3 months of storage, roots were removed from storage and reanalyzed for the previously described characters. Roots were then placed back in storage for further root rot observations.

We plan to repeat the experiment in 1975 and the results of the entire study will be available in the 1975 Sugarbeet Research Report blue book.

GENETIC AND BREEDING RESEARCH

The Effect of Plant Population on Components of Purity and Sugar Yield. --G. A. Smith and K. A. Ash.--A two year study was initiated in 1974 to examine changes which may occur among components affecting purity and among components of recoverable sugar as population densities are changed. Our recent experience in developing a model to best explain purity has not given us a model which accounts for a high proportion of variation in purity from one test to another. We have not, however, considered the possible effects of plant density and the possibility that a specific density may give us a true picture of purity components. Plant populations of 7,927, 11,890, 23,780, and 47,561 plants per acre, are being grown at two nitrogen fertility levels. Two current commercial varieties and one line developed at Fort Collins are being utilized in the experiment.

The ideal model may, in fact, be developed from a specific plant density and at a specific nitrogen fertility level. This does not negate the possibility that a model developed at one population density and or nitrogen level is applicable to other nitrogen level plant density combinations. The models, which are developed after the 1975 test is completed, will be presented in the 1975 Sugarbeet Research blue book. Table 1 presents the results of the 1974 test which will be used to develop the 1974 purity models.

Table 1. The means for ten characters for 3 varieties grown at two nitrogen levels and 4 plant population densities.

N[1] level	Pop.[2] density ppa	Rec. sugar	Character measured[3] Sucrose %	Purity %	Na	K	Cl	NO_3N	Amino N	Betaine	Total N
Regular	47,561	7365	18.34	95.35	15.5	117.6	9.8	7.5	26.2	351.3	97.1
	23,780	6652	18.36	95.01	16.9	123.0	12.9	6.7	27.2	372.2	92.4
	11,890	6282	18.04	95.25	21.2	131.9	18.7	9.0	29.8	376.4	112.2
	7,927	5089	17.57	94.51	29.6	144.9	22.9	12.1	32.4	376.7	109.6
High	47,561	7612	17.85	94.51	20.6	121.7	9.2	7.2	31.1	362.0	114.7
	23,780	6733	17.84	94.26	24.3	128.8	12.4	7.6	32.1	381.6	115.4
	11,890	6108	17.30	94.39	28.1	135.2	15.7	13.5	34.3	384.8	123.5
	7,927	5061	16.86	93.32	32.9	147.6	18.7	18.5	37.4	415.0	132.8

[1] The regular nitrogen treatment of the experiment was approximately 60 lbs of actual N applied pre-plant and the high nitrogen treatment was an additional 100 lbs of actual N applied post plant side dress as NH_4NO_3.

[2] ppa = plants per acre.

[3] Recoverable sugar expressed as lbs per acre. Non sucrose characters expressed as milligrams per 100 milliliters.

Beta maritima X *Beta vulgaris* as a Source of Cercospora Leaf Spot Resistance.--G. A. Smith.--In our ongoing efforts to develop good leaf spot resistant lines, we have made crosses and backcrosses of *Beta vulgaris* X *Beta maritima*. Backcrosses utilizing several *Beta vulgaris* lines as the recurrent parents have produced populations from which selections and intercrosses have been made. Throughout this endeavor, maximum attention has been given to maintaining a broad genetic base and consequent general population heterogeneity and vigor.

Selections have been made for leaf spot resistance under artificially induced leaf spot epidemics and for sucrose and root weight under non-leaf spot conditions. Selections were then crossed using a modified polycross system. The new populations were again grown under leaf spot and non-leaf spot conditions and again selected for leaf spot, sucrose %, and root weight, respectively.

The program thus far has resulted in a population which exhibits very good field leaf spot resistance and which is very vigorous.

As indicated in the following table, the root size and sucrose % have been increased significantly over the original population. The population is very heterogeneous and does maintain a fair gene frequency for monogerminity. If further tests, which are scheduled for 1975, are favorable, this germ plasm will be considered for release through the Beet Sugar Development Foundation (to be used as a potential wide base pollinator).

Means, ranges and standard deviations of selected polycross and unselected populations of *Beta vulgaris X Beta maritima*.

Population	Sucrose %			Root weight(g)			Leaf spot rating[1/]
	$\bar{x}$	s	range	$\bar{x}$	s	range	
selected	21.06	.92	20.0-23.4	862.4	219.9	605-1664	2-3
unselected	18.74	1.52	14.5-23.4	630.9	243.1	263-1664	2-3

1/ Leaf spot rating based on 0-10 scale with 0 being no visible leaf spot and 10 being complete defoliation.

Test of USSR Varieties.--G. A. Smith and R. J. Hecker.--Twenty-three imported Russian varieties were evaluated at several locations in the U.S including Fort Collins. The Fort Collins tests included evaluation for root weight, sucrose %, and purity under non-disease conditions and disease readings for Cercospora leaf spot and Rhizoctonia root and crown rot under inoculated field conditions. Appropriate checks for disease and non-disease tests were included. The non-disease tests were conducted using a balanced lattice design with six replications. This same

Table 1. Test of USSR Varieties, Fort Collins, Colorado, 1974.

Seed no.	Description	Weight $\bar{x}$[1/]	Sucrose $\bar{x}$	Purity $\bar{x}$	Leaf Spot 9/10	Leaf Spot 9/18	Rhizoctonia % H	Rhizoctonia D.I.
A74-29	Belotserkovsk polyhyb. 2	11.454abc	16.632abc	95.117a	4.8a	3.8a	0.4d	5.33abc
" -30	" " 1	12.596ab	15.495c	94.483a	4.5a	3.8a	7.2cd	4.98bc
" -31	Kirghizian polyhyb. 18	12.604ab	17.598abc	95.667a	4.8a	3.8a		
" -32	Kubanian polyhyb. 9	12.092ab	17.897ab	95.417a	4.8a	3.8a	4.9cd	5.10abc
" -33	L'govsk 078	12.883ab	16.807abc	94.933a	4.5a	3.5a		
" -34	Mezhotnensk 070	11.813abc	16.685abc	95.450a	4.5a	3.8a	13.5cd	5.30abc
" -35	" 080	11.738abc	17.363abc	96.100a	5.5a	3.8a		
" -36	" 104	10.763bc	16.680abc	96.033a	5.5a	4.3a	3.0cd	5.98ab
" -37	Pervomaisk 028	10.342bc	16.192bc	95.983a	4.0a	3.5a	14.4cd	4.85bc
" -38	" polyhyb. 10	12.579ab	16.815abc	94.183a	3.8a	3.5a	11.8cd	4.78c
" -39	Ramonsk 06	9.429bc	15.618c	95.117a	5.0a	4.0a	4.6cd	4.80bc
" -40	" 09	7.633c	16.272bc	94.950a	4.3a	3.5a	0.0d	6.33a
" -41	" 023	11.171abc	16.408bc	94.667a	6.0a	4.0a	5.0cd	5.03abc
" -42	" 036	13.033ab	16.845abc	95.367a	6.0a	4.0a	19.9bc	4.63c
" -44	" 100	10.346bc	16.860abc	95.333a	3.3a	3.0a	4.8cd	5.35abc
" -45	Uladovsk 096	10.483bc	16.232bc	94.833a	5.0a	4.0a	1.3d	5.90abc
" -46	" 752	10.988abc	15.942bc	95.717a	5.5a	4.0a	4.6cd	5.50abc
" -47	Verkhynyachsk 031	10.292bc	16.893abc	95.367a	3.5a	3.3a	1.6cd	6.10ab
" -48	" 072	12.021ab	17.202abc	95.833a	4.3a	3.5a	4.0cd	6.00ab
" -49	" 098	13.638ab	16.648abc	95.583a	5.5a	4.0a		
" -50	Uladovsk 20	10.608bc	16.680abc	94.950a	5.5a	3.5a	0.4d	5.45abc
" -51	Vnisovsk polyhyb. 5	13.092ab	16.020bc	94.733a	4.5a	3.8a	0.7d	5.23abc
" -52	Yaltushkovsk monogerm	11.554abc	17.165abc	94.750a	5.5a	3.5a	6.9cd	5.35abc
" -28	(US H10B; uniform check)	11.058abc	17.172abc	94.617a	5.0a	4.0a	2.3cd	5.45abc
A72-7	(GW Mono HyA1; local check)	15.129a	18.570a	95.000a				
Acc.2269	Synthetic Check; LSS check				5.5a	3.8a		
671201H08	FC(504x502/2)xSP 6322-0;LSR ck				3.5a	3.5a		
711006-0	FC 701/4;7 cy.Rh.sel. check						34.3b	2.78d
LSD .05		2.69	1.34	1.46	1.81	0.67	14.84	1.09
CV %		20.34	7.00	1.35	18.40	8.81	67.23	15.43

1/ Weight recorded as kg/plot. To convert to tons/acre multiply by 1.3068

NOTE: Means followed by the same letter are not significantly different at the 5% level according to Duncan's multiple range test.

design was used at the other locations testing the same Russian varieties. The results of the Fort Collins test are presented in the following table. No significant differences for purity were found among the varieties and all entries were equal to the check varieties. For root weight, the majority of the varieties compared favorable with the uniform check, however, none of the varieties surpassed the local check. Sucrose percentages, on general, compared favorable with the local checks but again none of the entries surpassed the local check. None of the varieties showed significant resistance to Rhizoctonia. Leaf spot readings under a less than satisfactory epidemic, tended toward susceptability.

Test of Polish, French, and Spanish Accessions under Non-disease Conditions and Polish and French Accessions under *Cercospora* Leaf Spot Conditions.--G. A. Smith and R. J. Hecker.--Twenty-six foreign entries from Poland, France, and Spain were evaluated either under disease-free conditions, or under *Cercospora* field inoculation, or both, in 1974. The following table presents the results of those tests. For sucrose %, 14 accessions equaled or exceeded the local checks. Six Polish lines (A74-5, 6, and 7, A74-54, and A74-58 and 59) compared favorably with the local checks for both root weight and sucrose %. Several Polish and Spanish accessions equaled the local checks for root weight only.

For Cercospora resistance, Polish entry A74-4 reported to be resistant to Cercospora, did show good resistance to the disease in our test and two other Polish lines A74-57 and A74-56 were as good in leaf spot resistance as the local resistant check.

Polish, French, and Spanish accessions under non-disease conditions. Polish and French accessions under leaf spot conditions.

Accession number	Description	Sucrose (%)	Rt. weight[1] (kg)	Cercospora readings 9/10/74	Cercospora readings 9/18/74
A74-1	Fr. From Deesprez Seed Co., mm,self sterile, very bolt.res. in N.France ± Z type. MS side of cross. ± 17% suc. Equiv. of 10217T.	16.66	23.525	5.0	3.8
A74-2	Fr. From Deesprez Seed Co., mm,self sterile, "0" type No. 2, 10217T.	17.36	23.542	6.5	4.3
A74-3	Pol. "Short root" type sel. for several gens. for short root type.	18.56	27.217	4.0	3.3
A74-4	Pol. CR-P35989. LSR line.	18.57	23.783	3.3	2.5
A74-5	Pol. AJ_1-ZZ. Sel. line from an AJ_1 var. of high sugar content.	21.19	27.067	4.5	3.0
A74-6	Pol. SN-4X-ZZ. Green hypocotyl.	20.49	30.758	4.0	3.3
A74-7	Pol. AJ_3-4X-Z. AJ_3-4X-Z. Sel line from AJ_3 variety.	19.78	27.708	3.8	3.5
A74-8	Pol. AJ_1-4X-ZZ. Sel. from AJ variety.	18.57	30.642	4.0	3.3
A74-9	Pol. mm 2X. Obtained from MM variety $PZHR_4$.	19.83	18.075	5.0	3.8
A74-10	Pol. mm 2X. Obtained from MM variety $PZHR_4$.	21.42	17.675	3.0	3.0
A74-20	Span. Aula Dei 13. 2N,MM high sucrose, ♂ parent of A74-26.	20.20	22.708		
A74-21	Span. Aula Dei 36. 2N,MM,high sucrose.	20.62	25.225		
A74-22	Span. Aula Dei 91. 2N,MM,bolting res. ♂ parent of A74-27.	18.06	29.708		
A74-23	Span. Aula Dei 645. 4N,MM,high tolerance to Cercospora infection.	19.50	28.550		
A74-24	Span. Aula Dei 646. 4N,MM,high tolerance to Cercospora infection.	19.37	25.525		
A74-25	Span. Aula Dei 842. 4N,MM,high suc., a parent of commercial polyploid var. in N.Spain.	20.15	21.733		
A74-26	Span. Aula Dei 8413. 4N,high suc.,MM, low yield.	20.34	21.692		
A74-27	Span. Aula Dei 70491.4N,MM,bolt.res. high yield, low suc.,Swedish origin.	18.71	31.792		
A74-54	Pol. PN-triploid experimental hybrid.	20.10	30.433	4.0	3.5
A74-55	Pol. *Beta vulgaris* X *B.maritima*-F_6.			4.5	3.3
A74-56	Pol. *Beta maritima* - biennial form.			3.3	2.8
A74-57	Pol. F_1/MS 562 X 569;MS562 X 5461,LSR	17.89	26.900	3.8	2.5
A74-58	Pol. AJ Polycana-aniso-ploid,MM var.	20.09	31.242	4.5	3.5
A74-59	Pol. AJ Polycana-aniso-ploid,MM var.	20.59	30.658	5.0	3.3
A74-60	Pol. *Beta vulgaris* X *B.maritima*-F_1.			4.0	3.5
A74-61	Pol. *Beta vulgaris* X *B.trigyna*-F_5 diploid.			3.8	3.0
A72-7	Check GW Mono Hi A1	19.08	31.083		
A73-13	Check FC 506 X FC 902,Am-2 hyb. C	19.06	28.650		
671201H08	FC(504X502/2)X SP 6322-0,LSR check			3.0	2.8
Acc 2269	Synthetic check, LSS check			5.5	3.8
LSD .05		1.60	4.68	1.18	0.86
CV %		4.10	8.78	13.43	12.62

[1]Weights recorded as kg/plot. To convert to tons/acre multiply by .6533.

Recurrent and Reciprocal Recurrent Selection in Sugarbeet.--R. J. Hecker.--We have been carrying on small recurrent and reciprocal recurrent selection projects for a number of years in order to evaluate these breeding techniques as a means for improvement of sugarbeet. Our recurrent selection for general combining ability has now been carried through five cycles. In theory, this breeding method should improve the general combining ability of a population. We have now completed 2 cycles of reciprocal recurrent selection. This breeding method should simultaneously improve the combining ability of two populations; the improvement in each should be complementary with the improvement in the other.

At this time, we have synthetic and composite populations generated from these breeding studies. Table 1 shows the per se performance of these populations. These results give us some useful information however, it is combining ability rather than per se performance that is most important. The combining ability comparisons of these same populations are in process and will be included in subsequent reports which will summarize all the data.

Briefly, the recurrent selection study started with GW 359, a multigerm, open pollinated, former commercial variety. Phenotypic selections were made from GW 359 with equal emphasis on yield and sucrose. These first selections were polycrossed and asexually propagated. Seed was harvested from each polycrossed plant and then used in progeny tests. The asexual propagations of mother plants with superior progeny performance were interpollinated to form the 1st cycle synthetic of asexual propagations. This synthetic population was used to start the second cycle of selection from which limited phenotypic was made. Again these selections were polycrossed and progeny tested. The 2nd cycle synthetic resulted from interpollination of polycrossed seed from mother plants with superior progeny performance for yield and sucrose, each character being about equally weighted. The 3rd, 4th, and 5th cycle synthetic populations were developed in the same manner. The 5th cycle synthetic of S_1's resulted from interpollination of S_1 plants from those 5th cycle mother plants with superior progeny performance.

No significant improvement in root yield was achieved through five cycles of recurrent selection (Table 1). The 3rd cycle synthetic appeared to have a significantly lower root yield than the source population (GW 359).

There were significant improvements for sucrose content in the 1st and 3rd cycle synthetics, and a tendency for all synthetics to have more sucrose. For purity there were no differences or trends between source and synthetic populations.

Hence, these five cycles of recurrent selection with equal emphasis on root yield and sucrose content resulted in some improvement of sucrose but no improvement of yield or purity. Since the method is designed to improve the combining ability of plants with each other, any combining ability improvement should have been reflected in these synthetic populations.

Table 1. Root yield, sucrose, and purity means of populations from recurrent and reciprocal recurrent selection studies.

Population	Kg/plot	% suc	Purity
Recurrent Selection			
GW 359 (source)	12.40	17.9	95.7
1st cy. syn. asex.	11.80	18.4*	95.6
2nd cy. syn.	12.95	18.2	95.9
3rd cy. syn.	10.85*	18.5*	96.0
4th cy. syn.	11.07	18.2	95.6
5th cy. syn.	11.38	18.2	95.4
5th cy. syn. of S_1's	12.00	18.1	96.0
Reciprocal Recurrent Selection			
Am #2 mono (source A)	11.30	18.2	95.7
comp. 1st cy. A X B	12.81*	17.8	95.7
comp. 2nd cy. A X B	13.48*	18.3	95.8
comp. 1st cy. 18 sup. A X B	13.42*	18.3	95.3
2nd cy. syn. A (yield)	12.64*	18.2	96.0
2nd cy. syn. A (suc)	10.68	18.6*	96.2
2nd cy. syn. A (rec suc)	10.99	18.5	95.9
GW 359 (source B)	12.40	17.9	95.7
comp. 1st cy. B X A	12.30	17.8	95.8
comp. 2nd cy. B X A	12.59	18.1	95.8
comp. 1st cy. 22 sup. B X A	12.85	18.1	95.9
1st cy. syn. B	13.36	18.0	95.7
2nd cy. syn. B (yield)	12.56	17.8	95.9
2nd cy. syn. B (suc)	12.54	18.4*	95.6
2nd cy. syn. B (rec suc)	12.95	18.4*	95.8

*denotes a significant difference (.05) from the source population in each group.

Later tests for combining ability should corroborate the per se results of these synthetics. Therefore, we have failed in our objective to identify and isolate superior combining genotypes. The most logical explanation for this failure is a combination of three factors, 1) the use of polycrossed seed to form the 2nd, 3rd, and 4th cycle synthetics, rather than asexual propagations or S_1 plants from superior maternal plants, 2) simultaneous selection for two characters, coupled with, 3) relatively few progeny lines evaluated each cycle (as few as 27 and 30 in the first and second cycles, respectively). Therefore, it is likely that any recurrent selection breeding program to improve general combining ability would have to involve large numbers of progeny evaluations in order to identify those few individuals with superior combining ability.

This would be particularly true if the goal was simultaneous improvement of two or more characters. Also, the preservation of the maternal genotype by selfing or asexual means is probably essential for significant improvement, based on the results of similar breeding studies in corn.

Table 1 also lists the means of various populations resulting from reciprocal recurrent selection. This breeding study commenced with phenotypic selections from Sources A and B. These were crossed reciprocally using hypocotyl color for hybrid identification. Those plants destined to be maternal plants were also selfed. These test cross progenies were compared for yield and sucrose and 1st cycle synthetics were made from S_1 seed of superior maternal plants. The second cycle was the same except three synthetics were generated from S_1 seed of maternal plants with superior progeny for yield, sucrose, and recoverable sucrose, respectively.

Source A was Am. #2 Mono, a former commercial monogerm variety from American Crystal Sugar Co., developed for more eastern beet growing areas. It is not well adapted in northern Colorado.

Significant improvements for yield and sucrose were made in Source A by bringing together in a synthetic population those genotypes which performed best in combination with Source B genotypes. Only sucrose improvement was demonstrated in Source B synthetics. The sucrose improvements probably resulted from capitalization on additive genetic effects. The breeding method should not yet be condemned because of the failure to improve Source B, since it is designed to identify and isolate those genotypes which combine best with the other source population. The combining ability tests currently in process will determine if this combining ability has been improved.

There is one serious deficiency in the use of reciprocal recurrent selection in beets, which applies to this study. That is the inability to achieve 100% hybrids in the A X B and B X A test crosses. In this experiment, the test crosses were about 75% hybrids and 25% sibs. Unless the combining ability of source A with B was quite dramatic, the masking effect of 25% sibs in the test hybrids would probably prevent the identification of high combining genotypes in the A and B populations. If this dilution effect due to sibs in the test crosses is too great, then it may be necessary to use techniques similar to those used in corn. This may be impractical in beets, however, due to self sterility and the inability to pollinate a large number of plants with a specific maternal plant of the other source. The combining ability phase of this breeding study should provide information on the effectiveness and practicality of using reciprocal recurrent selection in sugarbeet.

Test Hybrids Involving Rhizoctonia Resistant Pollinators.--R. J. Hecker.--In our breeding program for rhizoctonia resistance, the greatest emphasis has been given to development of pollinator lines. This is because of two considerations, (1) partial dominance for resistance may cause hybrids from susceptible females and resistant pollinators to be adequately resistant to natural rhizoctonia infections and, (2) there are less complicating factors with which to contend, such as monogerm, type O, and CMS.

Several breeding lines with varying degrees of rhizoctonia resistance were used as pollinators on a group of cytoplasmic male sterile (CMS) lines. This group of CMS's consisted primarily of single crosses which are currently used in commercial hybrids. The CMS's were provided by breeders in the industry. Two lines from Poland were also used as pollinators on some of these CMS's. There were a total of 92 test hybrids of the possible 143 from 11 pollinators and 13 CMS's. Insufficient numbers of steckling plants prevented us from making all 143 possible crosses.

Root yield, sucrose content, purity, and recoverable sucrose were determined. The pollinator and male sterile parents of the experimental hybrids are listed in Table 1, along with the means of all hybrids involving each parent. Among the rhizoctonia resistant pollinators, those derived from leaf spot and curly top resistant (LSR-CTR) sources have not combined well with the CMS's used. This serves as an indication of their combining ability. FC 701/4, FC 702/4, and FC 703 combined much better and appear to have some potential as pollinators of commercial hybrids. Pollinator 10, a Polish tetraploid, produced the highest yielding hybrids in the test. All the means in Table 1, however, are not directly comparable, since they involve different numbers of hybrids.

The best experimental hybrids are listed in Table 2 along with the checks. The Polish tetraploid pollinator combined quite well with several of the CMS's. Also, the three rhizoctonia resistant pollinators combined reasonably well with certain CMS's. However, only one experimental hybrid in the entire test significantly exceeded the local check for recoverable sucrose.

These evaluations of experimental hybrids are part of our rhizoctonia resistance breeding program. They serve as a means of evaluating combining ability of our breeding lines. Specific combinations are also of interest of course, and certain of these superior specific combinations will be tested more extensively.

Table 1. Pollinator and CMS parents used in experimental hybrids, and the mean of all hybrids involving each parent.

Parent	Source	No.of hybs.	Mean of experimental hybrids: Yield (T/A)	Sucrose (%)	Purity (%)	Rec. sucrose (T/A)
Pollinators						
1. Rhiz.res.,LSR-CTR,mm, TO	Rhiz.prog.	2	16.91	17.8	96.4	2.78
2. Rhiz.res.,MM, misc. sources including B. maritima	Rhiz.prog.	6	18.35	18.3	95.8	3.05
3. Rhiz.res.,mm,LSR-BRR, largely from 5831-0	Rhiz.prog.	6	18.38	17.1	95.3	2.83
4. Rhiz.res.,LSR-CTR,mm, TO	Rhiz.prog.	12	16.61	18.6	96.3	2.83
5. Rhiz.res.,LSR-CTR,mm, TO	Rhiz.prog.	6	17.20	18.3	96.2	2.90
6. Rhiz.res.from FC 901 & 903	Rhiz.prog.	4	17.31	17.1	95.3	2.67
7. FC 701/4;6 cy.Rh.sel.	Rhiz.prog.	13	18.33	18.0	95.4	2.96
8. FC 702/4;6 cy.Rh.sel.	Rhiz.prog.	13	18.26	18.7	95.7	3.10
9. FC 703	Rhiz.prog.	13	18.75	18.8	95.8	3.20
10. Polish 203/71(4n);MM	Poland	11	19.70	19.0	96.2	3.43
11. Polish Mono IHAR;mm	Poland	6	17.87	18.2	95.8	2.96
CMS's (females)						
1. 11866 X 12163	Am.Cry.	11	17.62	18.2	96.1	2.96
2. GW-918	GW	11	18.79	18.2	95.6	3.09
3. 63-(5HO X 6)	Am.Cry.	10	18.35	18.0	95.7	3.00
4. 67MSH154	GW	5	17.51	19.3	96.0	3.07
5. H65-02-69	Holly	9	19.45	18.2	95.5	3.20
6. 100363MS X 12166	U-I	9	18.04	18.4	95.8	3.03
7. E929	Amal.	9	18.31	18.3	95.8	3.05
8. 562CMS X 569	ARS,Salinas	5	16.78	18.5	95.5	2.78
9. E 01	Amal.	5	17.03	18.8	95.8	2.91
10. 9399-02	Holly	5	19.15	18.4	95.8	3.20
11. 7301	Amal.	5	18.68	18.5	96.1	3.17
12. 95	Amal.	4	17.68	18.5	96.4	3.01
13. 300/71	Poland	4	16.60	18.4	96.0	2.79

Table 2. The top experimental hybrids and the checks in the 1974 test of hybrids involving rhizoctonia resistant and other pollinators.

Hybrid or check	Yield (T/A)	Sucrose (%)	Purity (%)	Recov.suc. (T/A)
3 X 7 [63-(5HO X 6) X FC 701/4]	20.28	18.4	95.4	3.37
6 X 7 [(100363MS X 12166) X FC 701/4]	21.15	17.6	95.4	3.34
1 X 8 [(11866 X 12163) X FC 702/4]	20.94	18.2	95.1	3.43
5 X 8 [H65-02-69 X FC 702/4]	20.53	19.2	94.4	3.43
7 X 8 [E 929 X FC 702/4]	19.92	19.6	94.9	3.51
10 X 8 [9399-02 X FC 702/4]	20.30	19.1	96.0	3.54
2 X 9 [GW-918 X FC 703]	20.99	18.1	95.5	3.43
5 X 9 [H65-02-69 X FC 703]	20.26	18.6	95.5	3.41
6 X 9 [(100363MS X 12166) X FC 703]	19.50	19.4	95.7	3.46
10 X 9 [9399-02 X FC 703]	21.99	18.4	95.5	3.65
11 X 9 [7301 X FC 703]	19.39	19.0	96.0	3.37
1 X 10 [(11866 X 12163) X Polish (4n)]	20.50	19.3	97.0	3.73
2 X 10 [GW-918 X Polish (4n)]	19.03	19.9	97.2	3.53
4 X 10 [67MSH154 X Polish (4n)]	18.44	20.4	96.4	3.46
5 X 10 [H65-02-69 X Polish (4n)]	23.69	18.4	96.4	4.00
6 X 10 [(100363MS X 12166) X Polish(4n)]	18.84	19.3	96.5	3.36
7 X 10 [E 929 X Polish (4n)]	20.94	18.5	95.9	3.53
11 X 10 [7301 X Polish (4n)]	20.73	19.2	95.8	3.59
GW Mono Hy A1 (check)	20.28	18.4	96.1	3.40
GW Mono Hy D2	21.18	18.1	96.0	3.47
HH21	17.95	19.2	95.9	3.13
FC 701/4	14.16	18.7	95.9	2.41
FC 702/4	13.06	19.1	95.7	2.26
FC 703	14.34	18.9	96.7	2.51
LSD (.05)	2.97	1.1	1.5	0.39

QUALITY RESEARCH

Simultaneous Determination of Glucose, Fructose, and Sucrose by Gas-liquid Chromatography.--S. S. Martin.--For physiological and quality evaluation of sugarbeets, analysts frequently have need to determine glucose and fructose, the primary reducing sugars present in the beet. It is also often of interest to examine the relative proportions of these monosaccharide reducing sugars to sucrose. Simultaneous determination of sucrose, glucose, and fructose is complicated by large quantitative differences in their presence in the usual beet juices and extracts---typically a ratio of about 100:1 (w/w) sucrose:reducing sugars. This problem can be overcome by combining

the sensitivity of gas-liquid chromatography (GLC) and the large linear range of response of an electronic integrator. In using GLC analysis, a second problem arises: the formation of multiple peaks by glucose and fructose with the usual trimethylsilyl (TMS) derivatization procedures. This difficulty can be overcome by reacting the sugars with hydroxylamine hydrochloride to convert them to the corresponding oximes, then preparation of the volatile TMS ethers of the oximes. The following is a useful procedure developed in preliminary work, although it is expected further refinements will be made.

1. Accurately pipet out a quantity of aqueous sample containing about 10 mg total sugars. Add acetone and evaporate off the acetone-water azeotrope twice under a light stream of air at ca. 40° C.

2. To the dry sample, add 0.5 ml of a pyridine solution containing 25 mg/ml hydroxylamine hydrochloride and about 15 mg/ml (the exact concentration must be known for quantitation) trehalose as an internal standard. Heat at 70° C for one hour.

3. Cool; add 0.5 ml trimethylsilylimidazole in pyridine (3:1 v/v TSIM:pyridine). Cap and shake well, then heat at 50-60°C for 15 min. Cool and analyze by GLC.

Samples prepared as above have been analyzed on a Hewlett-Packard 5712A gas chromatograph using a thermal conductivity detector and helium carrier gas (50 ml/min), an electronic integrator, and fitted with dual 6' X ¼" OD columns packed with 10% OV-17 on Chrom W. Satisfactory separations were obtained using an initial column temperature of 200° C (8 min hold), temperature programming at 16°/min to 270° (8 min hold). Under these conditions the compounds of interest eluted as follows:

Compound	Retention r_t
Fructose	5.30 min
Glucose	6.74
Sucrose	15.67
Trehalose (internal std.)	17.26

In preliminary tests it also appears the method can be modified to use of dimethylformamide (DMF) as the solvent in place of pyridine. It would probably also be desirable to incorporate an internal standard eluting with the monosaccharides. The method as described, yields samples near the lower limit of detection by thermal conductivity under the conditions described; use of the more sensitive flame ionization detector would be preferable. Studies to further improve the analytical method and its application to various sugar beet extracts are in progress.

Quality Characteristics and Sucrose as Affected by Sample Preparation. --R. J. Hecker and S. S. Martin.--Over the past 4 years we have conducted experiments on the effect of sample preparation on sucrose and nonsucrose constituents in sugarbeet brei, juice extracts, and other juices. Results of some of these experiments have been described in our 1972 and 1973 reports. However, as described below, some aspects of the results over the past 4 years have not been satisfactorily consistent or conclusive.

We have had two primary objectives in these experiments: 1) to determine the types of samples permitting accurate quantitative determinations of sucrose, purity, and nonsucrose chemical characters, and 2) to develop means of using individual chemical components in a functional manner to assess beet quality.

Results of one test in the experiments, comparison of the sucrose content of fresh and frozen brei, are shown in Table 1. Brei from freshly harvested beets was well-mixed and sampled; one portion was analyzed immediately, whereas a second portion was placed in a freezer at -20° F. Freezing was not always immediate, but occurred within a few hours in all cases. The frozen brei, after 2 or more weeks at -20° F, was subsequently thawed at room temperature and analyzed for sucrose content. In comparisons of sucrose content means for the two types of sample in each of 4 years, the only statistically significant difference occurred in 1973 between the samples from low nitrogen fertility plots. Also, the two sample types from 1973 high nitrogen fertility plots were on the verge of significant difference. In view of the excellent agreement of the data for the two sample types in the other 3 years, we cannot explain the discrepancies found in 1973, except to suggest that they might have arisen from an unrecognized problem in polarimeter standardization. Further comparisons of fresh and frozen brei under more closely controlled conditions are in progress and will be included in our 1975 report.

Table 1. Comparison of fresh brei and frozen brei for pol sucrose content (%).

	1971	1972		1973		1974	
		Low N	Excess N	Low N	Excess N	Low N	Excess N
Fresh brei	13.6	14.3	13.7	16.7 *	16.6	18.4	16.4
Frozen brei	13.8	14.2	13.6	17.3	17.0	18.5	16.6
No.samples/mean	55	100	100	24	24	14	14

*Significant difference between fresh and frozen brei.

Quality and nonsucrose characters as determined on several different juices and extracts over the past 4 years are summarized in Table 2. Chemical data from the 1974 experiment are not yet available. The extracts and juices were prepared as follows:

1:1 ext. = 1 brei : 1 distilled water (w/w), blended 3 min., vacuum filtered, analyzed immediately.

1:1 ext. froz. = extract as above, stored frozen ca. 3 weeks, thawed at room temp. and analyzed.

1:1 froz. brei ext. = brei stored frozen, thawed at room temp., extracted as above and analyzed.

1:1 hot ext. froz. = extract as above except with boiling water; stored frozen ca. 3 weeks, thawed at room temp. and analyzed.

1:1 cent. ext. froz. = 1 brei : 1 distilled water extracted through a centrifugal vegetable juicer, extract stored frozen, thawed at room temp. and analyzed.

leaded suc. filt. = sucrose filtrate from standard sucrose determination, stored frozen, thawed at room temp. and analyzed.

lab thin juice = laboratory thin juice prepared from limed pressed juice stored frozen ca. 3 weeks; this is the thin juice from our standard purity process.

Our interest in these extracts as samples for determination of quality and quality-related components is in part governed by practicality. Obviously, for example, any juice requiring preparation and immediate analysis is impractical for large numbers of samples unless a fully automated analysis of the components of interest were in use. Similarly, unless hot water extraction were clearly the only suitable method, it is relatively less practical than other extractions simply because of the necessity for boiling water. Moreover, the blended hot water and cold brei results in a slurry having a temperature too low to significantly denature proteins but almost ideal for microorganism growth. From the standpoint of extract preparation alone, the leaded sucrose filtrate would be an ideal juice with which to work, as it is always available from the sucrose analysis. Its possible drawbacks are in the analytical complications and possible compositional alterations introduced by the lead compounds added in the sample defecation process. The 1:1 frozen brei extract is in our estimation the second most practical sample type, followed closely by the 1:1 ext. froz., and 1:1 cent. extract; each of these would be reasonably practical to prepare quickly and in large numbers.

One problem apparent in the data of Table 2 is the thin juice purity differences among the extracts, particularly the purity differences in 1972 and 1973 between lab thin juice (our standard purity method) and several of the extracts. Thin juice and frozen brei extract purities were the same, however, in 1974. Obviously, the purities should be the same unless the method of sample preparation or handling results in the release of differing quantities of nonsucrose compounds into the extract, or in differential extraction or degradation of sucrose in the purity process. We are attempting to clarify the nature of sample handling effects on purity in experiments currently in progress.

Table 2. Quality and chemical characters of sugarbeet extracts and juices over 4 years.

Year and treatment	T.J. % pur.	Extract % suc.	Extract RDS	Extract % pur.	mg/100 g sucrose Ash	NO_3	Cl	Na	K	Amino N	Total N
1971											
1:1 ext.	90.1	7.2	8.48	83.6	4778	1480	174	1028	1119	297	1353
1:1 froz. brei ext.	90.0	7.2	8.42	84.3	4721	1494	169	1066	1158	303	1424
1972											
1:1 ext.	93.2	7.1			3283	154	97	273	722	120	647
1:1 ext. froz.	93.4	7.0			3276	151	95	267	722	112*	608*
1:1 froz. brei ext.	93.0	7.5*			3244	163	101	292	709	108*	591*
1:1 hot ext. froz.	91.4*	7.1			3369	155	98	293	741	112*	598*
1:1 cent.ext.froz.	97.0*	7.0			3458	163	105	317*	724	114	580*
leaded suc. filt.		1.8†			21695*	120*	47*	496*	884*	96*	807*
lab thin juice	95.8*	11.6†			3228	167	104	354*	710	86*	278*
1973											
1:1 froz. brei ext.	95.7	8.6			2155	11	40	49	667	24	519
leaded suc. filt.		2.1†			12778*	20*	23*	71*	772*	65*	318*
lab thin juice	96.3*	12.5†									
1974											
1:1 froz. brei ext.	94.9										
lab thin juice	94.7										

*Indicates significant difference from 1st treatment in each year. Comparisons within years only.

†Not comparable statistically with the other treatments in each year due to dilution difference.

Another inconsistency evident from Table 2 involves differences within 1972 data and 1973 data in nitrate, chloride, Na, K, amino N, and total N between the leaded sucrose filtrate and other juices. Again, experiments in progress are designed to examine the effects of sample preparation and handling on analytical results.

Our second objective in these experiments, to develop methods of using individual components in a functional manner to assess quality, has not yet been satisfactorily accomplished. Our approach has involved the use of path coefficient analysis to rank the relative direct effects of independent variables on purity and then multiple regression analysis to establish the functional relationship of the independent variables (X's) and purity, the dependent variable (Y). The following three functions (purity prediction models) have served about equally well in predicting thin juice purity:

1. $\hat{Y} = 95.41 - 5.629\ K + 0.409\ Ash - 4.569\ Na + 0.149\ Sucrose$
2. $\hat{Y} = 96.46 - 1.247\ Ash - 6.35\ Amino\ N$
3. $\hat{Y} = 97.58 - 0.922\ (2.5\ K + 3.5\ Na + 10\ Amino\ N)$

In these models the units of the X variables is mg/100 g sucrose, except for sucrose which is in actual concentration, expressed as percent, in the solution. Each of these models has accounted for about 85% of the variability in purity in the data from which the model was developed. However, in one set of unrelated data the three models accounted for only 9%, 30%, and 27%, respectively, of the variability in purity. Hence, the need exists for further work in this area. We are proceeding with effort along this line. Part of the problem is the relatively large error variance associated with purity as it is normally determined. This will remain a problem unless a more rigid determination of purity is employed.

An interesting observation from this work has been the multiple regression results showing that conductivity ash substituted quite well for Na and K. In other words, if ash was entered into the step-wise regression first, followed by Na and K, the Na and K accounted for very little addition variability in purity. Conversly, if Na and K were entered first, ash contributed very little additional improvement of the model.

Continued work is planned in this entire area, and results will appear in subsequent reports.

SUGARBEET RESEARCH

1974 Report

Section D

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North Dakota Agricultural Experiment Station
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CONTENTS

STORAGE ROT RESEARCH

W. M. Bugbee

Bacteria and invert sugars in healthy tissue of stored sugarbeet

Extractable sucrose decreases in sugarbeets during storage. The metabolism of microbial inhabitants, particularly the production of invertase, might contribute to this decrease in sucrose quality. The objectives of these investigations were (1) to measure bacterial populations of healthy sugarbeet roots during storage at 5C; (2) identify the most prevalent colonies; and (3) compare bacterial populations with invert sugar levels.

Bacterial populations were measured in two cultivars: American 4 Hybrid A (4A) and Mono-Hy D2 (D2). Roots were stored in perforated plastic bags at 5C. Cores 18 mm in diameter were removed with a cork borer from each of 50 roots for each cultivar. The same roots were sampled at 30-day intervals during a 150-day storage period. The epidermal ends of the cores were removed (2-5 mm) and the cores were trimmed to 10 gm. Disinfection was accomplished by suspending each core in 1% sodium hypochlorite for 15 secs followed by one rinse in sterile distilled water. Juice was extracted from each core with the aid of a vegetable juicer fitted with a paper filter. The juicer was flushed with 70% ethanol after each extraction. Sterile water was used instead of a core after 25 extractions to determine the effectiveness of the 70% ethanol wash. Filters were replaced after three extractions. Juice samples were diluted and plated in triplicate using the pour plate technique with nutrient agar as the medium. Incubation was at 26C. Cultures were purified by dilution.

Invert sugar levels in the extracted juice were measured using the 3, 5-dinitrosalicylic acid reagent.

The bacterial count at harvest was 5 X 10^4/ml juice for D2 and 7.2 X 10^4/ml for 4A. This difference was statistically significant (Fig. 1, left). The bacterial growth rate followed a normal sigmoid curve. Maximum average counts were 3.7 and 4.5 X 10^5/ml juice for 4A and D2, respectively. The cultivar 4A had significantly more bacteria per ml of raw juice than D2 up to 60 days storage. Thereafter, 4A continued higher than D2 but considerable variability in both cultivars removed statistical difference.

There was less variability in the invert sugar levels than in the bacterial counts. American 4A had significantly more invert sugar than D2 at harvest and throughout the storage period (Fig. 2, right). The invert level in 4A increased sharply after 90 days whereas the levels in D2 remained constant.

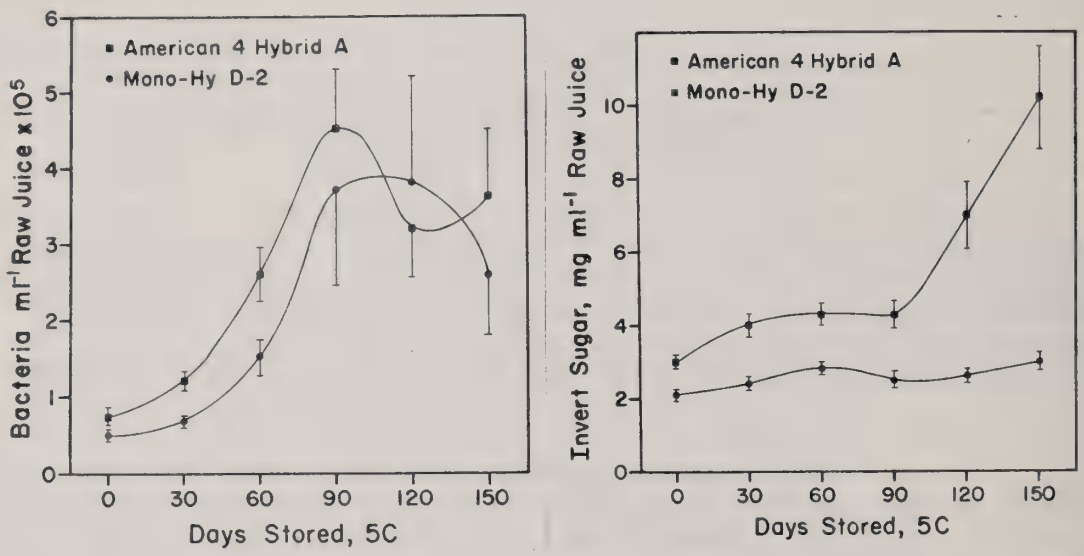


Fig. 1 left. Bacterial population in raw juice extracted from two cultivars of sugarbeets during the 150 days storage at 5C. Each point is an average of 50 roots. The same roots were sampled throughout the storage period.

Right. Invert sugar levels in the same raw juice samples described in Fig. 1, left. Invert sugar was determined with 3, 5-dinitrosalicylic acid reagent.

Verticle bars represent standard deviation.

The higher bacterial count in 4A together with the higher invert level suggests that the microflora could be contributing toward a storage loss of sucrose by inversion and utilization. Further, it is not known why 4A would support a greater population of bacteria than D2. Sucrose content of both cultivars was 11.2% after storage of 150 days. Roots of both cultivars used in these experiments were produced in the same field plot.

Identification of bacterial isolates--The following genera and number of cultures were represented in the 36 colonies that were isolated and purified: Pseudomonas 16, Bacillus 6; Brevibacterium 5; yeast 4; Erwinia 2; Flavobacterium 2; and Streptomyces 1. Eight of the isolates were identified to species: P. boreopolis, P. chlororaphis, P. effusa, F. aquatile, Bacillus subtilis, and Brevibacterium helvolum.

Of special interest because of the potential economic importance was the ability by 20 of the 36 cultures to hydrolyze sucrose in vitro. All genera except S. longisporus demonstrated this ability. Experiments to measure microbial hydrolysis of sucrose in vivo are needed to determine if this source of quality deterioration contributes toward the hydrolytic activity in the sugar beet.

Dispersal of Phoma betae in storage yards

Previous work has shown that Phoma betae, an important storage rot pathogen of sugarbeet, survives perenially in soils of sugarbeet storage yards. This investigation was conducted to determine if soil borne inoculum of P. betae could be dispersed to freshly harvested roots during the piling operation.

Air was sampled with microscope slides taped to the arms of a rotary sampler. The slides were coated (1-3 mm deep) with an agar medium selective for P. betae. The slides were exposed for six intervals of 2 min each at Moorhead, Ada (Crystal), and Ada (Red River Coop.) during the piling operation. Petri plates containing the selective agar medium were placed, five at a time, on the ground beneath the boom of the piler. The plates were spaced equidistant across the area onto which debris was falling from the boom. The plates were exposed for 15 min at each of the three piling stations. Slide and plate cultures were incubated 7 days at 22C.

Colonies of P. betae did not develop when slides containing the selective medium were exposed to the atmosphere around sugarbeet piles. Although conidia of P. betae were exuded in gelatinous matrix, thus not conducive to wind dissemination, it was theorized that plant debris embedded in the soil of the storage yard would be wind disseminated short distances due to truck activity under dry conditions.

Six colonies of P. betae developed from debris that fell from the piler boom onto the exposed petri plates. Four cultures were obtained from a piling station at Moorhead, Minnesota, and two cultures were obtained from Ada (Red River Coop.), where the piler and site were in use for the first time. Thus, infested fields were the source of inoculum. No colonies were obtained from Ada (Crystal). All six isolates were pathogenic on sugarbeet root tissue. Therefore, sugarbeets can be inoculated by Phoma laden debris as the roots are being piled.

Previous work has shown that P. betae will survive at least 26 months in the soil of our region. A 4-year rotation was suggested. Also, the amount of storage rot has been related to the prevalence of seed-borne Phoma. Presumably, seed-borne Phoma also would be a source of inoculum at the piling stations. The possibility that one infested load of beets could infest several clean loads that follow at the piler emphasizes the need by growers to practice 4-year rotations and seed processors to utilize fungicidal seed treatments effective against P. betae.

Two newly recognized pathogens of stored sugarbeet

Two species of Penicillium frequently have been observed in the laboratory growing from rotted portions of sugarbeet tissue. Many species of Penicillium are saprophytes living on dead tissue but the high prevalence of these species suggested possible pathogenic activity. The fungi were identified as P. claviforme and P. variabile.

Cores from roots of American 3 Hybrid T were inoculated with spores from each of the two species of Penicillium, placed in petri dishes, then incubated 2 weeks at 5, 10, and 20°C. Decayed tissue was removed, weighed and expressed as percent by weight of the entire core.

The results in Table 1 show P. claviforme more virulent than P. variabile being able to rot 17% of the cores in 2 weeks at 5°C while P. variabile induced no rot. Both are less virulent than Phoma betae or Botrytis cinerea. P. claviforme was present in 17% and P. betae in 26% of decayed tissue pieces from the Moorhead factory in December.

Table 1. Percent by weight of sugarbeet tissue decayed by Penicillium claviforme and P. variabile after 2 weeks incubation at various temperatures.

	°C		
Pathogen	5	10	20
	%	%	%
P. claviforme	17[a/]	90	100
P. variabile	0	81	78

a/ Average of four root cores for each of four replications.

Prevalence, severity, and cause of storage rot at the Moorhead factory

The amount (even rough estimates) of storage rot occurring each year is not known because no one has sampled and examined roots as they begin the factory process. Our objectives were to sample roots at the picking table then remove, weigh and identify the cause of rot.

Samples were collected on alternate days at 12 hr intervals. The time of collection was randomly selected. Roots were weighed, cut into quarters, rotted portions weighed then cut into smaller pieces and examined for pathogens using routine procedures. Data also were taken for the amount of crowns removed and percent of frozen tissue.

The data in Table 2 are from samples taken November 6-December 18. Most of the rot was in the body and crown. The rotted areas were associated with injuries.

Table 2. PERCENT BY WEIGHT OF FROZEN AND ROTTED TISSUE
Amount of crown removed expressed as percent of total roots examined.

Moorhead Factory

	Rot, %				
Frozen	Body	Tail	Crown	Pith	Total
11	0.2	0.08	0.2	0.1	0.6

Crown removed %		
None	Half	All
24	68	8

Total wt: 1294 lbs
Total number roots: 741
Total samples: 44

The rotted tissue during this six week sample period was 0.6% of the total weight of roots collected. About 201,600 tons of roots were processed during this period. Thus, about 1,210 tons of rotted tissue went into the factory.

Rotted tissue from the crown, pith, body, or tail were removed, pooled, and eight randomly selected pieces were examined for the pathogens causing the rot. The pathogens and the percent of the tissues with which they were associated were: Phoma 26%, Fusarium 28%, Penicillium 13%, Rhizopus 10%, and Botrytis 2%.

Abstract of Papers Approved for Publication

Bugbee, W. M. and O. C. Soine. 1974. Survival of Phoma betae in soil. Phytopathology 64:1258-1260.

In field plots, the highest numbers of propagules of Phoma betae were found in April of the first year following sugarbeet culture. Soils were sampled from naturally infested plots of six crop rotations used in this region. The fungus was recovered as long as 26 mo after sugarbeets had been planted, but not in the third year following sugarbeets.

Phoma betae invaded the roots of lambsquarters (Chenopodium album) growing in cultivated fields and sugarbeet storage yards. The fungus rarely invaded the roots of oats. The fungus was present in soil from sugarbeet storage yards throughout the Red River Valley of North Dakota and Minnesota. Populations decreased during the summer, but the fungus was still present when roots from the new crop were being stored.

Bugbee, W. M. and K. J. Pazdernik. 1973. A precision planter for sugarbeet plots. J. AASBT 17:(in press).

A commercial John Deere Model 33 vegetable seed planter was modified for use as an experimental plot planter. Monogerm sugarbeet seed can be space-planted precisely, and excess seed can be discarded quickly at the end of each plot. This planter will help to conserve seed and speed up the thinning operation of sugarbeet seedlings.

Bugbee, W. M. 1974. Peroxidase, polyphenoloxidase, and endopolygalacturonate transeliminase activity in different tissues of sugarbeet infected with Phoma betae. (Approved by ARS for publication in Can. J. Bot.).

The storage rot pathogen Phoma betae normally attacks the exposed stem pith of harvested sugarbeets (Beta vulgaris L.) prior to invading adjacent stem and tap root tissues. A comparison of rotted and sound tissues of nonselected roots showed that increased polyphenoloxidase activity occurred in rotted stem tissue but peroxidase decreased. Endopolygalacturonate transeliminase (endoPGTE) was more active in rotted pith tissue compared to other rotted tissue. Comparison of rotted tissue from resistant and susceptible inbreds showed the greatest difference in oxidase activity occurred in resistant tap root tissue. Higher polyphenoloxidase activity was associated with resistant stem tissue of nonselected roots when catechol was the substrate rather than chlorogenic acid. Phoma betae growth in liquid culture was inhibited more by oxidation products of catechol than by those of chlorogenic acid. Peroxidase activity was associated with resistance

only in stem and tap root tissue of inbreds. EndoPGTE activity was low in infected resistant tissue. When isolated cell walls of nonselected sugarbeets were used as the carbon source, P. betae grew more and endoPGTE activity was greater on cell walls from pith than cell walls from adjacent stem or tap root tissue after 6 days incubation.

Bugbee, W. M. 1975. Dispersal of Phoma betae in sugarbeet storage yards. (Approved by ARS for publication in Plt. Dis. Reptr.)

Wind dispersal of soil-borne inoculum of Phoma betae was not found near sugarbeet storage piles during the piling operation, even though the fungus is known to survive perenially in soils of storage yards. P. betae was detected in debris that fell from the boom of the piler as it traversed the face of the pile. Thus, storage piles may be inoculated during the piling operation with Phoma-laden debris from infested fields.

Bugbee, W. M., D. F. Cole, G. Nielsen. 1975. Microclora and invert sugars in healthy tissue of stored sugarbeet. (Approved by ARS for publication in Applied Microbiology).

Bacterial populations in healthy tissue of sugarbeet roots stored at 5C followed a normal growth curve. Average counts showed a 6-fold increase after 150 days of storage. Invert sugar levels increased over 3-fold in 'American 4 Hybrid A' and remained fairly constant in 'Mono-Hy D-2'. The former cultivar also had significantly higher bacterial colony counts than the latter prior to 90 days storage.

Of 36 isolates identified, 16 were Pseudomonas spp. including P. boreopolis, P. chlororaphis, P. effusa; 6 Bacillus spp. including B. subtilis; 4 yeast; 5 Brevibacterium spp. including B. helvolum; 2 Flavobacterium spp.; 2 Erwinia spp; and Streptomyces longisporus. Isolates of all genera except S. longisporus were able to hydrolyze sucrose in vitro.

PHYSIOLOGY AND STORAGE RESEARCH - Fargo

Darrell Cole

Storage research during the past year included: (1) effects of irrigation and nitrogen; (2) effects of herbicides and a growth regulator; (3) effects of excess nitrogen and cultivars; (4) respiration rates of 6 commercial cultivars; (5) effect of mechanical damage on respiration.

Increase in leaf size of two cultivars were measured on leaves initiated at different periods of the growing season. Yield and sucrose content of two cultivars which were planted on June 16, 1974, and irrigated up were measured. Effects of nitrogen and phosphorus on sucrose, extractable sucrose, and percent crown tissue were determined.

For storage experiments sugarbeet roots were harvested from all replications of three separate experiments in the fall of 1973. Roots were harvested manually and the petioles were hand trimmed at the base and the growing point removed. The roots from all replications were combined and separated into three classes (large, medium, and small) from each treatment. Samples of 10 beets were obtained by blending the three classes depending upon the number of beets in each class. Each sample of 10 beets was stored in a perforated plastic bag (15 x 29 in) at 40 F for 150 days. At harvest and 50-day intervals thereafter, samples from each treatment were removed and pulp was obtained by sawing with a "Sprecke1's" saw. Pulp samples were immediately frozen and stored at -5 F for later analysis.

Apparent sucrose was determined polarimeterically by the cold digestion method and invert sugars by 3,5-dinitrosalyclic acid.

Chemicals

This experiment was conducted at the North Dakota Experiment Station at Fargo, ND. Biuret, being tested as a growth regulator (L-102), and 3 herbicides were used in this experiment. Trichloracetic acid (TCA) was applied as a pre-emergence spray (May 15) at 8 lb/A. Phenmedipham (methyl m-hydroxycarbanilate m-methylcarbanilate) was applied as a post-emergence spray (June 20) at 1 lb/A and EPTC (S-ethyl dipropylthiocarbanate) was incorporated before planting at 3 lb/A rate. The growth regulator was applied 45 days prior to harvest at 50 lb/A. All plots were hand weeded throughout the growing season. The field experimental design was a randomized complete block with 6 replications. Seed of 'American 2 Hybrid B' was planted on May 15, 1973. Soil test data showed a residual of 330 lb/A as NO_3 to a depth of 60 cm. Six samples of 10 beets of each treatment were analyzed at each sampling period during storage.

Invert sugars of all treatments increased during the 150-day storage period. EPTC caused a significant increase in invert sugar after 150 days storage over the control, whereas invert sugar from roots grown with phenmedipham were significantly lower than the control. Apparent sucrose was significantly higher in all treatments compared to the controls, averaged over the storage period (Table 1). Sugarbeets grown with phenmedipham did not show a decrease in apparent sucrose, whereas the control beets showed a 14.2% decrease.

Table 1. Effect of 3 herbicides and a growth regulator on apparent sucrose of sugarbeet roots averaged over a 150-day storage period.

Treatment	Apparent Sucrose, %
Phenmedipham	13.9 a*
L-102	13.8 ab
EPTC	13.5 bc
TCA	13.3 c
Control	12.7 d

* Values followed by the same letter are not significantly different according to Duncan's Multiple Range Test.

Irrigation and Nitrogen

Seed of 'HH-10' were planted on April 24, 1973, at the Oakes Irrigation Experimental Site at Oakes, North Dakota. Phosphorus and potassium were plowed down at 150 lb/A of P_2O_5 and 75 lb/A of K_2O, respectively. Nitrogen (N) was broadcast at 0 and 100 lb/A. Main plots were water levels replicated 3 times, with nitrogen level as the split-plot. The main plots were irrigated by a sprinkler system. Water level 1 was dryland conditions with no irrigation water added. Water levels 2 and 3 were irrigated when soil water tensions were 660 and 550 millibars at 12 in, respectively. Water level 3 was considered the optimum level. A total of 10.4 inches of rainfall was received during the growing season. Water levels 2 and 3 received an additional 9.3 and 12.5 inches of water, respectively. Seven samples of 10 beets of each treatment were analyzed at each sampling period during storage.

Sugarbeet roots grown under moisture stress conditions had a higher invert sugar content after storage than did roots grown under optimum moisture conditions (Table 2). Nitrogen did not significantly affect invert sugar content of roots grown under the different moisture levels when averaged over the storage period. However, under the optimum moisture level, sugarbeet roots grown with additional nitrogen showed a 31% increase in invert sugar content at the end of

the storage period. Sugarbeet roots grown under the two moisture stress levels only showed a 5% increase in invert sugars due to nitrogen. Apparent sucrose was significantly reduced by the addition of N (Table 2). Sugarbeets grown under moisture stress conditions were significantly lower in apparent sucrose. All interactions between storage time, water level, and nitrogen were nonsignificant. Apparent sucrose did not show a significant decline in storage.

Nitrogen and Cultivar

The experiment was conducted at Fargo, ND, and planted on May 8, 1973. The experimental design was a split-plot (6 replications) with nitrogen as main plots and cultivars as sub-plots. Nitrogen (N) was applied at 300 lb/A and the residual soil level was 150 lb/A. 'American 4 Hybrid A' and 'Bush-Mono' were the cultivars tested. Six samples of 10 beets of each treatment were analyzed at each sampling period during storage.

High nitrogen did not significantly change invert sugar levels on two cultivars of sugarbeets stored for 150 days (Table 3). The storage date by cultivar interaction was the only interaction which was significant for invert sugar. Invert sugar increased significantly in American 4 Hybrid A with time in storage, especially after 100 days. American 4 Hybrid A was significantly higher in invert sugar averaged over all storage dates.

High nitrogen caused a significant reduction in apparent sucrose averaged over cultivars (Table 3). American 4 Hybrid A and Bush-Mono showed a reduction of 15.9 and 13.1% in apparent sucrose due to the addition of nitrogen. American 4 Hybrid A was significantly higher in apparent sucrose at harvest and after 150 days storage.

The results reported in these experiments indicate that several agronomic practices can affect changes in apparent sucrose and invert sugar levels during storage of the sugarbeet roots. The practices become increasingly important when temperature increases within the storage piles, since the beets deteriorate faster at higher temperatures.

Increase in impurities causes a reduction in the amount of sucrose that can be extracted from the roots. Therefore, it becomes critical that all factors which can affect the storability of sugarbeet roots be evaluated and managed to produce high quality roots for storage. These data show that nitrogen, cultivar, chemicals and moisture stress can significantly affect quality of the roots during storage.

Table 2. Effect of irrigation and fertilizer nitrogen on apparent sucrose and invert levels of sugarbeet roots averaged over a 150-day period.

Fertilizer Nitrogen (N)	Water Level 1	2	3	Mean
		Apparent Sucrose, %		
0	13.5	14.2	14.6	14.1 a*
100 lb/A	12.7	13.3	14.2	13.4 b
Mean	13.1 c	13.7 b	14.4 a	
		Invert sugar mg g^{-1} beet		
0	2.4	1.9	1.5	2.0 a
100 lb/A	2.2	2.0	1.2	1.8 a
Mean	2.3 a	2.0 b	1.4 c	

* Means followed by the same letter in a column or row are not significantly different according to Duncan's Multiple Range Test.

Table 3. Effect of high fertilizer nitrogen and cultivars on apparent sucrose and invert levels of sugarbeet roots averaged over a 150-day storage period.

Cultivar	Nitrogen Residual 165 kg/ha	High +330 kg/ha	Mean
		Apparent sucrose, %	
Bush-Mono	12.2	10.6	11.4 b*
American 4 Hybrid A	13.2	11.1	12.2 a
Mean	12.7 a	10.9 b	
		Invert sugar mg g^{-1} beet	
Bush-Mono	2.6	2.6	2.6 b
American 4 Hybrid A	3.4	3.9	3.6 a
Mean	3.2	3.0	

* Means followed by the same letter within a row or column are not significantly different according to Duncan's Multiple Range Test.

Respiration

Manually harvested roots of 6 sugarbeet cultivars (Bush-Mono, GWD-2, Beta 93, Am 4A, Am 4T, Am 2B) were stored for 150 days after harvest at 40 F and 100% relative humidity. Respiration rates were measured during the last 75 days of the storage period using gas chromatographic techniques.

Respiration rates were significantly different among cultivars and the rates increased during the storage period. Rates averaged over cultivars were 1.3 and 2.4 ml CO_2 kg^{-1} hr^{-1} at 75 and 145 days, respectively. Respiration rates of Mono-Hy D-2 were the lowest of all cultivars during the storage period (Fig. 1).

Roots of one cultivar (Am 2 Hybrid B) were selected from different harvesting operations of a commercial grower and stored at 40 F for 150 days to measure the effect of mechanical damage on respiration. Respiration rates of sugarbeet roots mechanically harvested and piled were 20% higher than rates of manually harvested roots (Fig. 2).

Leaf area accumulation

Leaves of two cultivars, 'Mon-Hy D-2' and 'HH-21', were selected when the petiole began to elongate, thereby allowing a label tag to be attached. Leaves selected were immature and had begun to unroll. Ninety leaves of each cultivar were tagged 5 times during the latter part of the growing season (Aug 13, 20, 27, Sept 3 and 24). Ten leaves of each cultivar were selected at random at periodic intervals (0, 1, 2, 3, 6, 7, 14, and 21 days) to determine leaf area and specific leaf weight. Leaf area was determined by photocopying the leaves and dividing the weight of the leaf images by the weight of a 1 cm^2 area of the same paper. Specific leaf weight (mg cm^{-2}, SLW) was the ratio of leaf dry weight (80 C for 24 hr) and leaf area.

Leaf area increased rapidly during the first 14 days after the leaves were tagged (Fig. 3). Cultivar differences were detected at 21 days when the leaves were tagged on Aug 20 and Sept 24. Leaves initiated later in the growing season were smaller than leaves initiated earlier in the growing season. Leaves do not enlarge as rapidly during the time period when sucrose is increasing in the root. Specific leaf weight changes drastically during leaf expansion (Fig. 4). Specific leaf weight is high during the early stages of leaf development, decreases as the leaves expand, and increases as the leaves mature.

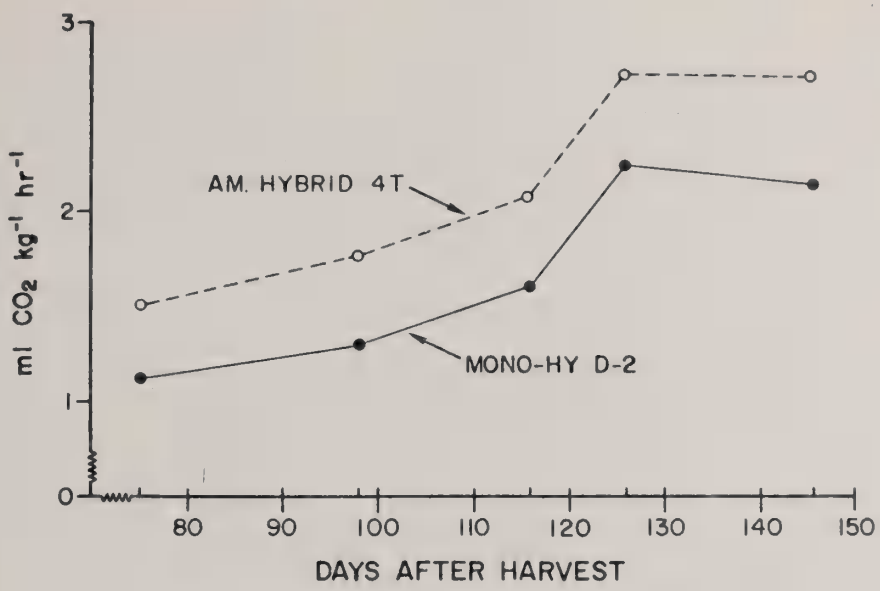


Fig. 1. Respiration rates of two cultivars of sugarbeet roots over a 75-day period.

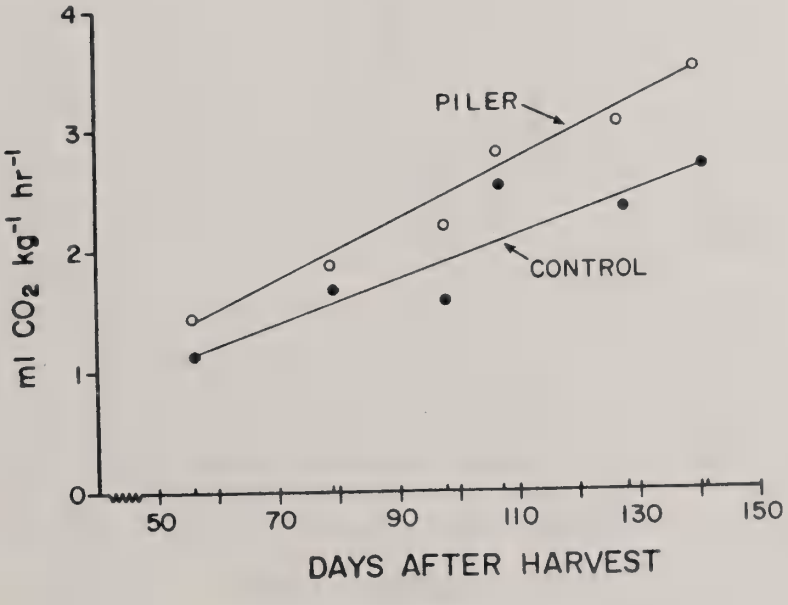


Fig. 2. Respiration rates of manually harvested roots versus roots harvested mechanically and piled.

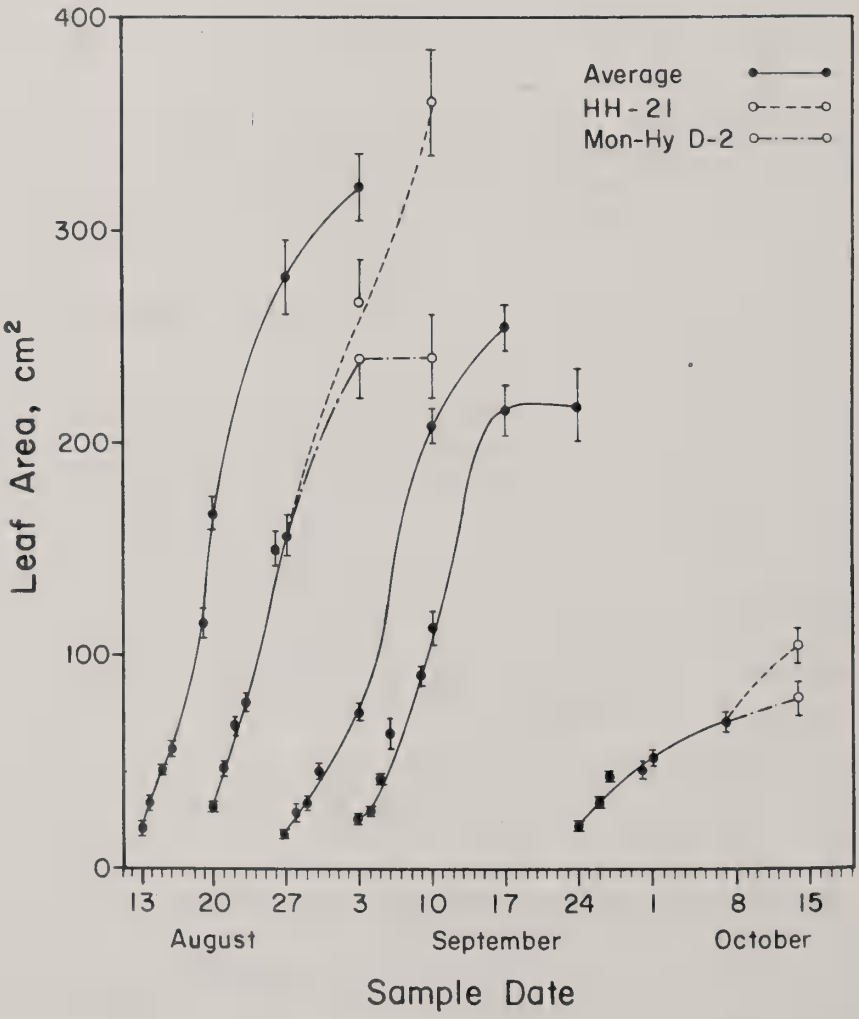


Fig. 3. Increase in leaf area of leaves initiated during the latter portion of the growing season. Vertical bars represent standard errors of the means.

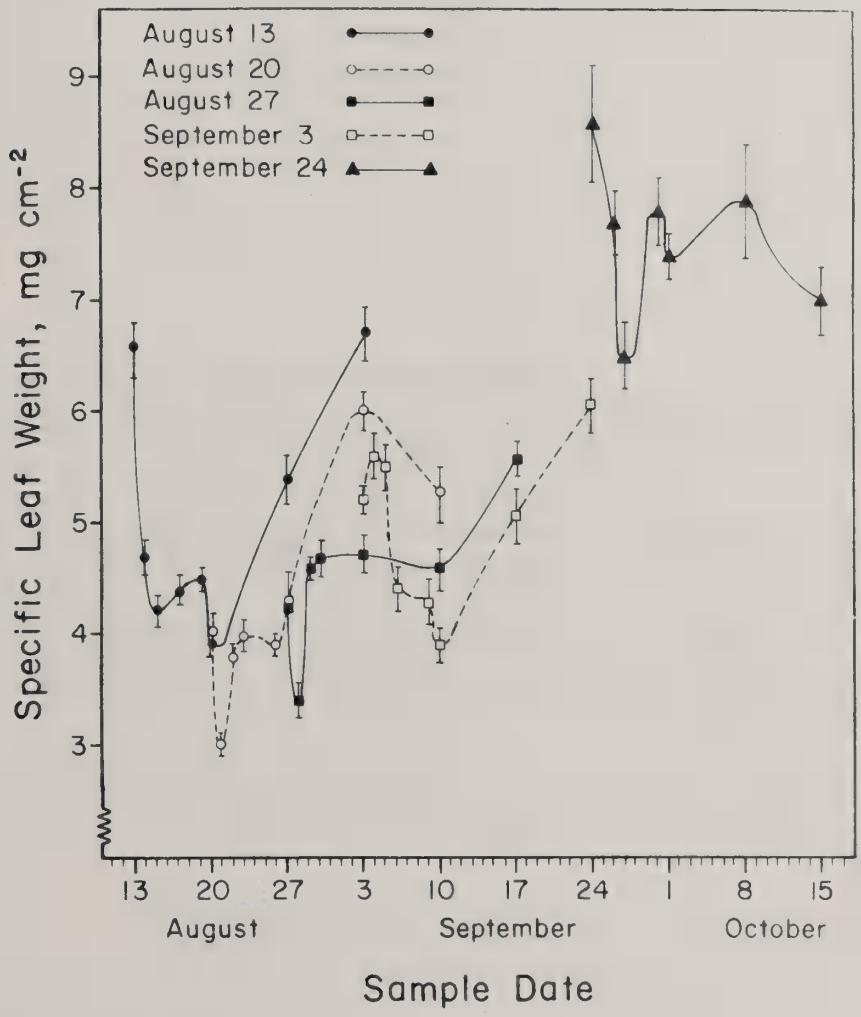


Fig. 4. Changes in specific leaf weight of leaves initiated during the latter portion of the growing season. Vertical bars represent standard errors of the means.

Late planting

Seed of two cultivars were planted on June 26, 1974, and irrigated up. Yield and sucrose content were determined on roots harvested Oct 25, 1974. There was no difference in yield between cultivars, however, sucrose was higher in Holly HH-21 (Table 4). Severe hail damage occurred on Aug 1 and probably reduced yields since over 90% of the leaves were completely obliterated.

Table 4. Yield and sucrose content of two cultivars planted June 26 and harvested October 25, 1974.

Cultivar	Yield Tons/Acre	Sucrose
HH 21	9.1*	13.4
Mon-Hy D-2	9.3	12.7

* Hail damage occurred August 1.

Nitrogen and Phosphorus

The effect of nitrogen and phosphorus on sucrose and percent crown tissue was determined on manually harvested beets. Roots were harvested and stored at 40 F for approximately 80 days. Root and crown tissue were separated at the lowest leaf scar on 20 consecutive beets in a row from each treatment. Nitrogen lowered apparent sucrose and extractable sugar and increased the amount of crown tissue (Table 5). The root tissue was lower in impurities and higher in apparent sucrose than crown tissue within treatments. Effects of phosphorus on apparent sucrose, extractable sucrose, and percent crown were not as clear cut as the nitrogen effects (Table 6). These data indicate that proper management of fertility can reduce the amount of crown tissue produced.

Table 5. Effect of nitrogen and manure on apparent sucrose and extractable sucrose averaged over root and crown tissue and percent crown tissue.

Treatment	Apparent Sucrose %	Extractable Sucrose %	Percent Crown %
Check	17.8	15.2	7.0
50 lb of N	17.0	14.1	9.7
100 lb of N	16.8	13.2	13.4
400 lb of N	10.6	7.7	15.3
10 ton manure	16.2	14.5	10.5
30 ton manure	15.1	11.7	11.4
LSD 0.05	0.4	1.2	2.2

Table 6. Effect of phosphorus on apparent sucrose and extractable sucrose averaged over root and crown tissue and percent crown tissue.

Phosphorus lb/A	Apparent Sucrose %	Extractable Sucrose %	Percent Crown %
0	17.0	12.7	16.8
20	17.0	13.6	20.1
80	16.6	12.9	22.8
LSD 0.05	NS	0.7	3.2

Abstract Published 1974

Cole, D. F. 1974. Respiration of sugarbeets during storage in a controlled environment. Agron. Abstract p. 70.

Manually harvested roots of 6 sugarbeet cultivars and mechanically harvested roots of 1 cultivar were stored for 150 days after harvest at 4C and 100% relative humidity. Respiration rates were measured during the last 75 days of the storage period using gas chromatographic techniques. Respiration rates were significantly different among cultivars and the rates increased during the storage period. Rates averaged over cultivars were 1.3 and 2.4 ml CO_2 kg -1 hr -1 at 75 and 145 days, respectively. Respiration rates of sugarbeet roots mechanically harvested and piled were 20% higher than respiration rates of manually harvested roots of the same cultivar.

CONTENTS

EVALUATION OF SUGARBEET HYBRIDS

G. J. Hogaboam

The hybrid evaluation program in 1974 was again conducted in cooperation with the Farmers and Manufacturers Beet Sugar Association (F&M) and its member companies. The "commercial" variety test of 9 entries at 8 locations was conducted by the F&M. The USDA coded the entries for this test and released code identification only after all data were analyzed. The F&M also conducted a "screening" test of 36 entries at 5 locations to evaluate possible candidates for this growing area. In addition to the two check varieties, US H20 and US H21, there were 11 USDA entries in the screening test and 3 in the commercial test. The data from the USDA entries in the screening test are reported here. The 1973 Area Evaluation Test, was repeated at 3 locations in 1974. Fifteen single-cross hybrids to multigerm pollinators were evaluated in a test with US H20 at Hamler, Ohio. Fifty-six hybrids were evaluated in another test at Pandora, Ohio.

The analysis of the juice for sugar and purity was done under the supervision of M. G. Frakes, Director of Research, Michigan Sugar Company.

The Holly Sugar Corporation provided completed computer-analysis of tests of 28 hybrids in a 9-replication test at Sidney, Montana and 22 hybrids in a 6-replication test at Torrington, Wyoming. Other companies also participated in the hybrid evaluation program. Results of these are not yet available, hence will be included in next years' report.

US H20 was included in all the Michigan and Ohio tests. It was not significantly exceeded in yield of recoverable white sugar per acre in any of the tests. Several hybrids gave promising performances and will be re-tested in 1975.

A study of 16 female components that had two different male parents in the 56 variety test revealed significant differences between females for recoverable white sugar per acre and tons of roots per acre. In the same comparison SP6822-0 was significantly superior to EL40 in transmitting high yield to the hybrids. However, EL40 was significantly superior to SP6822-0 in transmitting quality, as measured by recoverable white sugar per ton. It should be pointed out that these conclusions are based on only one test at Pandora, Ohio in 1974.

Performance of USDA hybrids included in the F&M Screening test

Hybrid			Pounds Recoverable White Sugar per Acre listed as:			Mean			
			Michigan			% of General Mean			
						Ohio			
CMS	"0"	Pollen	Richville	Sandusky	Average	Ottawa	Pandora	Hamler	Average
UI11866	x UI12166	x SP6822-0	7875.6	8074.2	7974.90	5640.5	6974.1	5405.2	6006.60
			106.7	106.1	106.40	106.0	106.4	113.5	108.63
FC506	x EL36	x SP6528-01	7644.0	7352.6	7498.30	5946.5	6893.9	4974.7	5938.37
			103.6	96.6	100.10	111.7	105.2	104.5	107.13
UI12166	x EL36	x SP6822-0	7942.9	7621.3	7782.10	6507.9	7410.0	5688.0	6535.30
			107.6	100.2	103.90	122.3	113.1	119.4	118.26
UI12166	x EL36	x SP6528-01	7449.2	6855.8	7152.50	6175.5	6773.2	4911.5	5953.40
			100.9	90.1	95.50	116.0	103.4	103.1	107.50
UI12166	x EL36	x EL40	7541.4	7225.0	7383.20	5394.0	6385.0	5602.0	5793.67
			102.2	95.0	98.60	101.3	97.4	117.6	105.43
UI102167E	x EL36	x SP6822-0	7991.3	8000.9	7996.10	5760.4	7499.9	5348.3	6202.87
			108.3	105.2	106.75	108.2	114.5	112.3	111.66
FC506	x UI12166	x SP6528-01	7527.2	7492.5	7509.85	5972.3	7214.8	5367.4	6184.83
			102.0	98.5	100.25	112.2	110.1	112.7	111.66
UI102167E	x UI12166	x EL40	7591.5	7796.0	7693.75	5739.8	7667.2	4877.8	6094.93
			102.9	102.5	102.70	107.8	117.0	102.4	109.06
UI104366B	x UI12166	x EL40	7690.8	8539.6	8115.20	5059.0	6684.1	5535.5	5759.53
			104.2	112.2	108.20	95.0	102.0	116.2	104.40
UI1861	x UI2161	x EL40	7658.3	7865.6	7761.95	5200.3	7361.2	5247.7	5936.40
			103.8	103.4	103.60	97.7	112.3	110.2	106.73
SP71550-01		x SP6822-0	7783.1	7177.4	7480.25	5140.8	6365.4	4590.6	5365.60
			105.5	94.3	99.90	96.6	97.1	96.4	96.70
FC506		x SP6528-01	6899.2	7602.4	7250.80	4670.9	6632.2	4510.4	5271.17
			93.5	99.9	96.70	87.7	101.2	94.7	94.53
UI11866	x UI12166	x SP6822-0	7593.5	8307.7	7950.60	6319.3	6530.3	4968.3	5939.30
			102.9	109.2	106.05	118.7	99.7	104.3	107.56
UI100363	x UI12163	x SP6822-0	7455.8	7249.0	7352.40	5414.1	7065.0	5384.7	5954.60
			101.0	95.3	98.15	101.7	107.8	113.1	107.53
General Mean - Actual			7379.8	7608.6	100.0%	5322.9	6552.4	4762.6	100.0%
LSD 5% - Actual			784.3	888.0	9.1%	724.9	905.4	741.5	11.3%
LSD 5% as % of G.M.			10.6	11.7	9.1	13.6	13.8	15.5	11.3
Coefficient of Variability			9.3	10.2	4.5	11.9	12.1	13.6	6.9

Performance of USDA hybrids included in the F&M Screening test

Hybrid			Tons of Roots per Acre listed as: Mean / % of General Mean						
			Michigan			Ohio			
CMS	"O"	Pollen	Richville	Sandusky	Average	Ottawa	Pandora	Hamler	Average
UI11866	x UI12166	x SP6822-0	24.3	25.8	25.05	22.0	27.0	20.8	23.27
			103.6	106.9	105.25	103.5	106.8	108.9	106.40
FC506	x EL36	x SP6528-01	24.8	24.5	24.65	23.7	26.5	19.5	23.23
			105.9	101.5	103.70	111.6	104.7	102.2	106.16
UI12166	x EL36	x SP6822-0	25.8	25.0	25.40	26.2	27.7	21.2	25.03
			110.0	103.7	106.85	123.4	109.7	111.0	114.70
UI12166	x EL36	x SP6528-01	24.1	21.8	22.95	24.6	25.7	19.4	23.23
			102.8	90.3	96.55	115.7	101.6	101.6	106.30
UI12166	x EL36	x EL40	23.7	23.5	23.60	21.3	24.7	21.8	22.60
			100.9	97.7	99.30	100.5	97.7	114.0	104.06
UI102167E	x EL36	x SP6822-0	26.0	26.6	26.30	22.6	29.0	21.6	24.40
			111.0	110.3	110.65	106.5	114.9	113.4	111.60
FC506	x UI12166	x SP6528-01	23.6	23.5	23.55	23.4	26.0	21.0	23.47
			100.5	97.4	98.95	110.3	103.0	109.8	107.70
UI102167E	x UI12166	x EL40	23.9	25.1	24.50	22.5	28.1	19.6	23.40
			101.7	104.2	102.95	105.7	111.0	102.9	106.53
UI104366B	x UI12166	x EL40	24.4	26.0	25.20	20.0	25.2	21.2	22.13
			104.0	107.9	105.95	94.0	99.6	110.9	101.50
UI1861	x UI2161	x EL40	24.2	25.3	24.75	20.9	27.7	20.1	22.90
			103.0	104.8	103.90	98.6	109.8	105.2	104.53
SP71550-01		x SP6822-0	23.9	22.1	23.00	19.7	23.1	18.0	20.27
			101.9	91.9	96.90	93.0	91.5	94.1	92.86
FC506		x SP6528-01	22.0	23.5	22.75	18.3	25.3	18.4	20.67
			93.8	97.4	95.60	86.2	100.2	96.4	94.26
UI11866	x UI12166	x SP6822-0	24.4	27.2	25.80	24.6	24.3	20.1	23.00
			103.9	112.7	108.30	115.8	96.1	105.3	105.73
UI100363	x UI12163	x SP6822-0	23.8	23.1	23.45	20.9	26.7	21.2	22.93
			101.6	95.9	98.75	98.7	105.7	110.9	104.90
General Mean - Actual			23.5	24.1	100.0%	21.2	25.3	19.1	100.00%
LSD 5% - Actual			2.3	2.7	8.7%	2.6	3.5	2.5	10.4%
LSD 5% as % of GM			9.7	11.1	8.7	12.3	13.9	12.8	10.4
Coefficient of Variability			8.5	9.7	4.3	10.8	12.2	11.3	6.4

Performance of USDA hybrids included in the F&M Screening test

Hybrid			Pounds Recoverable White Sugar per Ton listed as:			Mean % of General Mean			
			Michigan			Ohio			
CMS	"O"	Pollen	Richville	Sandusky	Average	Ottawa	Pandora	Hamler	Average
UI11866	x UI12166	x SP6822-0	324.1	313.4	318.75	256.7	258.8	259.9	258.47
			103.1	99.2	101.15	102.5	99.7	104.6	102.26
FC506	x EL36	x SP6528-01	307.2	301.6	304.40	250.8	261.8	254.5	255.70
			97.7	95.4	96.55	100.2	100.9	102.5	101.20
UI12166	x EL36	x SP6822-0	308.0	305.2	306.60	248.8	267.8	269.4	262.00
			98.0	96.6	97.30	99.3	103.2	108.5	103.66
UI12166	x EL36	x SP6528-01	309.6	315.5	312.55	251.5	263.8	250.4	255.23
			98.5	99.8	99.15	100.4	101.7	100.9	101.00
UI12166	x EL36	x EL40	318.1	306.5	312.30	252.9	259.9	257.1	256.63
			101.2	97.0	99.10	101.0	100.2	103.5	101.56
UI102167E	x EL36	x SP6822-0	306.7	301.4	304.05	254.5	258.4	246.4	253.10
			97.6	95.4	96.50	101.6	99.6	99.2	100.13
FC506	x UI12166	x SP6528-01	319.1	319.3	319.20	255.1	277.0	257.4	263.17
			101.5	101.0	101.25	101.9	106.8	103.6	104.10
UI102167E	x UI12166	x EL40	317.8	310.1	313.95	255.7	273.4	248.4	259.17
			101.1	98.1	99.60	102.1	105.4	100.0	102.50
UI104366B	x UI12166	x EL40	315.3	328.1	321.70	253.0	264.3	261.8	259.70
			100.3	103.8	102.05	101.0	101.8	105.4	102.73
UI1861	x UI2161	x EL40	317.0	311.5	314.25	248.2	265.3	260.3	257.93
			100.8	98.5	99.65	99.1	102.3	104.8	102.06
SP71550-01		x SP6822-0	325.4	324.6	325.00	260.6	275.1	255.3	263.67
			103.5	102.7	103.10	104.1	106.0	102.8	104.30
FC506		x SP6528-01	313.2	324.0	318.60	254.9	262.5	244.9	254.10
			99.6	102.5	101.05	101.8	101.2	98.6	100.53
UI11866	x UI12166	x SP6822-0	311.0	306.8	309.20	257.9	269.9	247.5	258.43
			98.9	97.1	98.00	103.0	104.0	99.7	102.23
UI100363	x UI12163	x SP6822-0	312.7	314.2	313.45	258.2	265.4	254.5	259.37
			99.5	99.4	99.45	103.1	102.3	102.5	102.63
General Mean - Actual			314.4	316.0	100.0%	250.4	259.5	248.3	100.00%
LSD 5% - Actual			12.3	14.5	4.0%	13.1	14.7	17.8	4.12%
LSD 5% as % of G.M.			3.9	4.6	4.0	5.2	5.7	7.2	4.12
Coefficient of Variability			3.4	4.0	2.0	4.6	5.0	6.3	2.53

Performance of USDA hybrids included in the F&M Screening test

Hybrid			Sucrose Percentage listed as: Mean % of General Mean						
			Michigan			Ohio			
CMS	"O"	Pollen	Richville	Sandusky	Average	Ottawa	Pandora	Hamler	Average
UI11866	x UI12166	x SP6822-0	18.83	18.55	18.69	15.50	15.75	16.07	15.77
			100.66	98.53	99.59	101.13	99.09	103.36	101.19
FC506	x EL36	x SP6528-01	18.26	18.05	18.16	15.29	15.99	15.77	15.68
			97.62	95.89	96.75	99.77	100.56	101.43	100.58
UI12166	x EL36	x SP6822-0	18.37	18.26	18.32	15.36	16.23	16.51	16.03
			98.20	96.97	97.58	100.24	102.08	106.20	102.84
UI12166	x EL36	x SP6528-01	18.28	18.56	18.42	15.27	16.01	15.62	15.63
			97.72	98.58	98.15	99.66	100.69	100.43	100.26
UI12166	x EL36	x EL40	18.88	18.44	18.66	15.50	15.87	15.89	15.75
			100.95	97.95	99.45	101.14	99.84	102.17	101.05
UI102167E	x EL36	x SP6822-0	18.24	18.14	18.19	15.55	15.68	15.38	15.54
			97.54	96.36	96.95	101.46	98.65	98.89	99.66
FC506	x UI12166	x SP6528-01	18.74	18.87	18.81	15.52	16.52	16.03	16.02
			100.20	100.22	100.21	101.31	103.93	103.12	102.78
UI102167E	x UI12166	x EL40	18.82	18.43	18.63	15.50	16.38	15.35	15.74
			100.64	97.90	99.27	101.17	103.02	98.69	100.96
UI104366B	x UI12166	x EL40	18.79	19.33	19.06	15.28	16.10	16.13	15.84
			100.47	102.66	101.56	99.75	101.28	103.76	101.59
UI1861	x UI2161	x EL40	18.86	18.65	18.76	15.17	16.11	16.01	15.76
			100.84	99.04	99.94	98.98	101.32	102.94	101.08
SP71550-01		x SP6822-0	19.10	19.15	19.13	15.57	16.56	15.91	16.01
			102.11	101.72	101.91	101.64	104.16	102.29	102.69
FC506		x SP6528-01	18.44	19.10	18.77	15.49	15.93	15.28	15.57
			98.62	101.42	100.02	101.07	100.19	98.27	99.84
UI11866	x UI12166	x SP6822-0	18.44	18.23	18.34	15.54	16.20	15.31	15.68
			98.60	96.82	97.71	101.43	101.94	98.44	100.60
UI100363	x UI12163	x SP6822-0	18.50	18.55	18.53	15.48	16.02	15.93	15.81
			98.93	98.53	98.73	101.04	100.76	102.47	101.42
General Mean - Actual			18.70	18.83	100.00%	15.32	15.90	15.55	100.0%
LSD 5% - Actual			0.54	0.63	3.05%	0.58	0.70	0.92	3.41%
LSD 5% as % of GM			2.90	3.36	3.05	3.83	4.39	5.92	3.41
Coefficient of Variability			2.54	2.95	1.50	3.36	3.85	5.20	2.09

Performance of USDA hybrids included in the F&M Screening test

Hybrid CMS	"O"	Pollen	Clear Juice Purity Percentage listed as: Michigan Richville	Michigan Sandusky	Michigan Average	Ohio Ottawa	Ohio Pandora	Ohio Hamler	Mean % of General Mean: Ohio Average
UI11866	x UI12166	x SP6822-0	95.22	94.25	94.74	93.64	93.17	92.34	93.05
			101.32	100.41	100.86	100.71	100.37	100.59	100.55
FC506	x EL36	x SP6528-01	94.07	93.71	93.89	93.20	92.96	92.28	92.81
			100.10	99.83	99.96	100.24	100.15	100.52	100.30
UI12166	x EL36	x SP6822-0	93.89	93.73	93.81	92.53	93.33	92.70	92.85
			99.91	99.85	99.88	99.52	100.55	100.98	100.35
UI12166	x EL36	x SP6528-01	94.42	94.56	94.49	93.38	93.31	92.01	92.90
			100.48	100.73	100.60	100.43	100.53	100.23	100.39
UI12166	x EL36	x EL40	94.06	93.39	93.73	92.88	93.03	92.40	92.77
			100.10	99.49	99.79	99.89	100.23	100.65	100.25
UI102167E	x EL36	x SP6822-0	94.03	93.41	93.72	93.03	93.33	92.00	92.79
			100.06	99.51	99.78	100.06	100.55	100.22	100.27
FC506	x UI12166	x SP6528-01	94.63	94.28	94.46	93.23	94.11	91.99	93.11
			100.71	100.44	100.57	100.27	101.39	100.21	100.62
UI102167E	x UI12166	x EL40	94.18	94.03	94.11	93.42	93.91	92.52	93.28
			100.22	100.17	100.19	100.48	101.17	100.78	100.81
UI104366B	x UI12166	x EL40	93.87	94.41	94.14	93.62	93.07	92.52	93.07
			99.89	100.58	100.23	100.70	100.27	100.79	100.58
UI1861	x UI2161	x EL40	93.94	93.64	93.79	93.05	93.26	92.63	92.98
			99.97	99.76	99.86	100.08	100.48	100.90	100.48
SP71550-01		x SP6822-0	94.63	94.34	94.49	94.14	93.63	92.02	93.26
			100.71	100.51	100.61	101.25	100.87	100.24	100.78
FC506		x SP6528-01	94.52	94.39	94.46	93.32	93.29	92.06	92.89
			100.59	100.56	100.57	100.37	100.51	100.29	100.39
UI11866	x UI12166	x SP6822-0	94.16	94.07	94.12	93.73	93.79	92.47	93.33
			100.20	100.22	100.21	100.81	101.05	100.73	100.86
UI100363	x UI12163	x SP6822-0	94.27	94.39	94.33	94.01	93.56	91.78	93.12
			100.32	100.55	100.43	101.11	100.80	99.97	100.62
General Mean - Actual			93.97	93.87	100.00%	92.97	92.81	91.80	100.00%
LSD 5% - Actual			0.70	0.84	0.62%	1.04	0.81	0.85	0.60%
LSD 5% as % of GM			0.74	0.90	0.62	1.13	0.87	0.93	0.60
Coefficient of Variability			0.65	0.79	0.31	0.99	0.77	0.81	0.37

Performance of USDA hybrids included in the F&M Screening test

Hybrid CMS	"O"	Pollen	Stand in Beets per 100 feet of row listed as: Michigan Richville	Michigan Sandusky	Mean % of General Mean Michigan Average	Ohio Ottawa	Ohio Pandora	Ohio Hamler	Mean % of General Mean Ohio Average
UI11866	x UI12166	x SP6822-0	96.9	109.7	103.30	99.4	95.3	76.7	90.47
			110.1	111.3	110.70	118.6	108.7	97.5	108.26
FC506	x EL36	x SP6528-01	85.3	101.9	93.60	83.6	92.8	81.4	85.93
			96.9	103.4	100.15	99.7	105.8	103.5	103.00
UI12166	x EL36	x SP6822-0	90.8	102.8	96.80	92.2	91.4	84.7	89.43
			103.2	104.2	103.70	110.0	104.3	107.8	107.36
UI12166	x EL36	x SP6528-01	90.0	91.7	90.85	90.8	95.0	76.4	87.40
			102.3	92.9	97.60	108.3	108.4	97.2	104.63
UI12166	x EL36	x EL40	86.4	91.1	88.75	84.4	84.4	84.2	84.33
			98.1	92.4	95.25	100.7	96.3	107.1	101.36
UI102167E	x EL36	x SP6822-0	101.1	103.9	102.50	84.2	92.5	93.6	90.10
			114.9	105.3	110.10	100.4	105.5	119.1	108.33
FC506	x UI12166	x SP6528-01	90.8	103.9	97.35	89.4	88.6	84.2	87.40
			103.2	105.3	104.25	106.7	101.1	107.1	104.96
UI102167E	x UI12166	x EL40	93.9	108.1	101.00	92.5	90.6	80.0	87.70
			106.7	109.6	108.15	110.3	103.3	101.8	105.13
UI104366B	x UI12166	x EL40	94.4	113.3	103.85	80.0	88.9	88.6	85.83
			107.3	114.9	111.10	95.4	101.4	112.7	103.16
UI1861	x UI2161	x EL40	89.2	103.1	96.15	88.1	93.3	83.3	88.23
			101.3	104.5	102.90	105.0	106.5	106.0	105.83
SP71550-01		x SP6822-0	98.1	98.1	98.10	90.8	93.9	77.2	87.30
			111.4	99.4	105.40	108.3	107.1	98.2	104.53
FC506		x SP6528-01	80.8	99.4	90.10	81.1	83.3	81.7	82.03
			91.8	100.8	96.30	96.7	95.1	103.9	98.56
UI11866	x UI12166	x SP6822-0	93.1	120.8	106.95	105.0	97.5	73.6	92.03
			105.7	122.5	114.10	125.2	111.2	93.6	110.00
UI100363	x UI12163	x SP6822-0	95.8	104.7	100.25	85.0	91.7	85.3	87.33
			108.9	106.2	107.55	101.4	104.6	108.5	104.83
General Mean - Actual			88.0	98.6	100.0%	83.8	87.6	78.6	100.0%
LSD 5% - Actual			10.6	12.6	10.0%	9.5	10.0	9.0	10.4%
LSD 5% as % of GM			12.0	12.7	10.0	11.3	11.5	11.5	10.4
Coefficient of Variability			10.6	11.2	4.9	9.9	10.0	10.1	6.4

USDA AREA EVALUATION

Hybrid Components			ID.	Performances in Percent General Mean of the Test # Rec. White Sugar per Acre			
CMS Parent	"0" Parent	Pollinator	No.	Hamler	Richville*	Bay City	Average
SP69550-01	UI12166	SP6822-0	1	104.4	104.7	107.6	105.6
"	"	SP6528-01	2	109.8	100.7	107.2	105.9
"	"	EL40	3	109.1	105.3	117.9	110.8
"	"	SP66288-24	4	100.7	103.3	101.3	101.8
SP69514-01	SP69550-0	SP6822-0	5	93.8	100.9	93.4	96.0
"	"	SP6528-01	6	101.4	101.2	98.3	100.3
"	"	EL40	7	95.4	95.5	89.9	93.6
"	"	SP66288-24	8	98.4	104.8	100.1	101.1
SP71550-01		SP6822-0	9	101.2	107.6	103.3	104.0
"		SP6528-01	10	100.3	94.3	96.3	97.0
"		EL40	11	95.9	94.9	96.4	95.7
"		SP66288-24	12	93.9	93.9	93.7	93.8
SP69557-01	SP69550-0	SP6528-01	13	89.2	103.0	92.6	94.9
"	"	EL40	14	94.5	93.8	91.4	93.2
"	"	SP66288-24	15	94.6	97.2	90.9	94.3
UI11866	UI12166	SP6822-0	16	117.6	99.0	119.8	112.1
	LSD 5% (for above units)			11.8	NS	11.7	7.8
	General Mean (Actual)			4996	6462	6660	100%
	Coefficient of Variation %			10.2	11.1	10.2	4.7

ID. No.	Tons of Roots per Acre				Recoverable White Sugar/Ton			
1	105.5	104.0	107.2	105.6	98.8	100.3	100.4	99.8
2	108.5	101.7	106.3	105.5	100.6	99.2	100.9	100.2
3	107.9	102.8	113.1	107.9	101.1	102.4	104.2	102.6
4	102.0	106.6	103.1	103.9	98.6	96.6	98.3	97.8
5	96.8	101.3	93.5	97.2	96.8	99.7	99.6	98.7
6	102.5	101.0	99.8	101.1	99.1	100.4	98.6	99.4
7	93.6	95.9	89.1	92.9	101.6	99.6	100.8	100.7
8	98.9	104.0	101.0	101.3	99.3	100.5	99.1	99.6
9	99.7	107.3	104.7	103.9	101.5	100.3	98.7	100.2
10	97.4	96.4	97.2	97.0	102.8	97.8	99.0	99.9
11	92.9	92.5	95.0	93.5	103.2	102.7	101.4	102.4
12	95.8	93.4	95.4	94.9	98.0	100.5	98.3	98.9
13	92.9	102.5	94.2	96.5	96.6	100.6	98.5	98.6
14	92.3	90.2	88.9	90.5	102.3	103.8	102.7	102.9
15	94.2	96.4	91.4	94.0	100.4	100.7	99.3	100.1
16	118.6	104.0	119.5	114.0	99.2	94.8	100.2	98.1
LSD	14.4	NS	15.9	6.3	NS	NS	2.6	2.6
GM	17.7	20.7	19.7	100%	281.9	313.1	337.3	100%
CV	8.6	10.1	9.5	3.8	5.2	3.9	2.3	1.6

USDA AREA EVALUATION

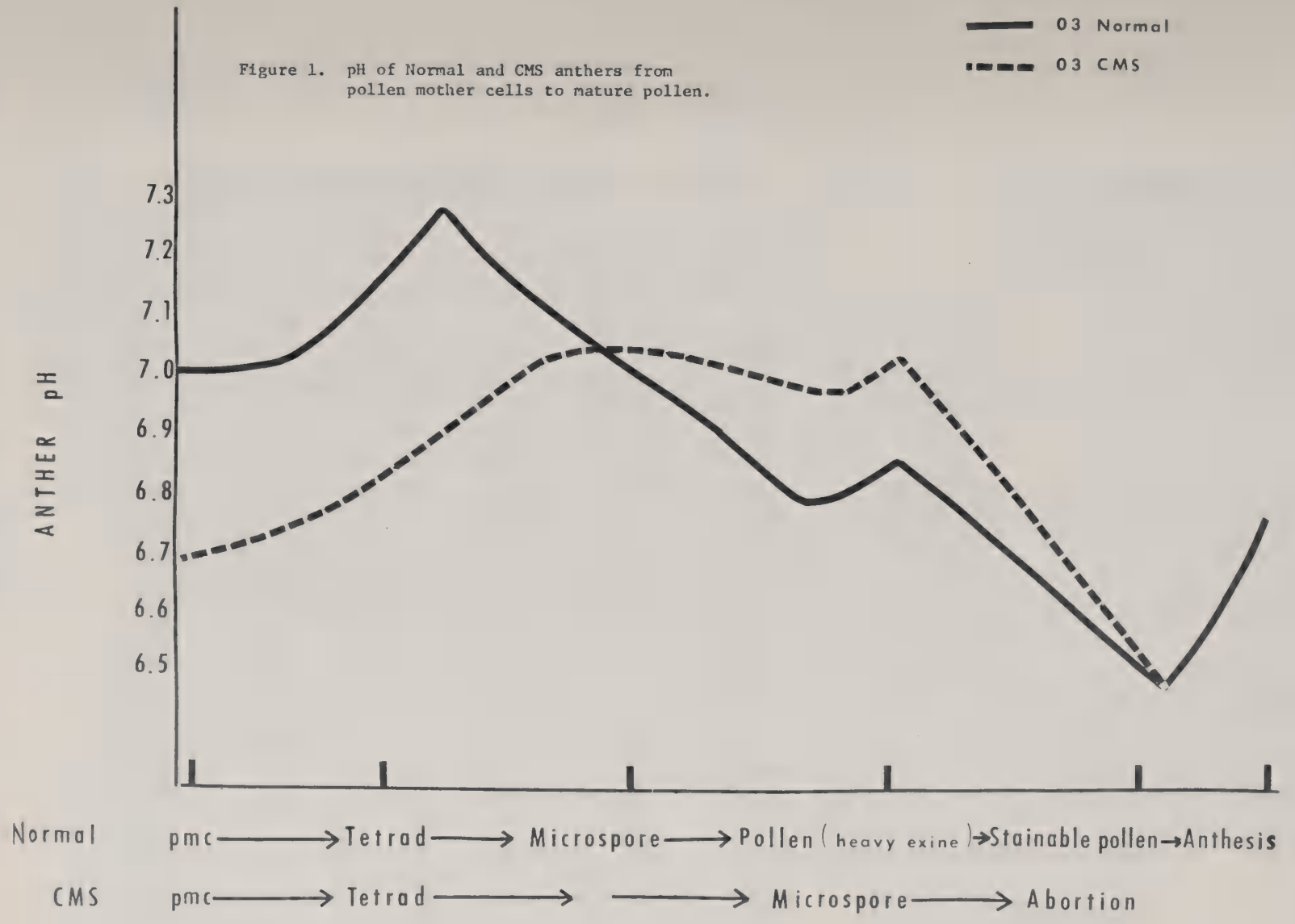
Hybrid Components			ID.	Performances in Percent General Mean of the Test Percent Sucrose			
CMS Parent	"O" Parent	Pollinator	No.	Hamler	Rich-ville*	Bay City	Average
SP69550-01	UI12166	SP6822-0	1	99.5	99.7	100.4	99.8
"	"	SP6528-01	2	100.2	98.9	100.4	99.8
"	"	EL40	3	101.3	102.2	104.1	102.5
"	"	SP66288-24	4	98.8	97.6	98.1	98.2
SP69514-01	SP69550-0	SP6822-0	5	97.4	99.6	99.3	98.8
"	"	SP6528-01	6	99.9	100.0	98.6	99.5
"	"	EL40	7	101.3	100.5	100.8	100.9
"	"	SP66288-24	8	99.6	99.7	99.7	99.6
SP71550-01		SP6822-0	9	101.1	100.1	99.5	100.3
"		SP6528-01	10	101.7	98.4	98.6	99.6
"		EL40	11	102.5	102.8	101.2	102.2
"		SP66288-24	12	98.4	100.7	99.2	99.4
SP69557-01	SP69550-0	SP6528-01	13	96.8	100.0	98.8	98.5
"	"	EL40	14	101.4	103.7	102.3	102.5
"	"	SP66288-24	15	100.5	100.6	99.7	100.3
UI11866	UI12166	SP6822-0	16	99.6	95.4	99.2	98.1
LSD 5% (for above units)				NS	4.0	2.5	2.1
General Mean (Actual)				17.0	18.8	19.2	100%
Coefficient of Variation %				4.2	2.9	2.2	1.2

ID. No.	Clear Juice Purity Percent				Beets per 100 Feet			
1	99.7	100.4	100.0	100.0	100.0	102.8	101.3	101.4
2	100.2	100.2	100.3	100.2	105.0	100.4	114.0	106.5
3	99.9	100.0	99.9	100.0	111.0	107.0	108.5	108.8
4	99.9	99.5	100.1	99.9	102.0	105.1	106.0	104.4
5	99.7	100.0	100.2	100.0	99.0	99.0	90.6	96.2
6	99.6	100.3	100.0	99.9	97.0	102.3	97.5	98.9
7	100.1	99.5	100.0	99.9	96.0	85.2	86.4	89.2
8	99.9	100.5	99.7	100.0	102.0	105.6	101.0	102.9
9	100.2	100.1	99.5	99.9	104.0	120.8	107.4	110.7
10	100.6	99.7	100.3	100.2	94.0	95.6	95.3	95.0
11	100.3	99.9	100.1	100.0	101.0	98.5	99.4	99.6
12	99.8	99.9	99.5	99.7	95.0	95.2	90.3	93.5
13	100.0	100.3	99.8	100.0	89.0	96.6	96.4	94.0
14	100.4	100.0	100.2	100.2	92.0	87.1	88.1	89.1
15	100.0	100.1	99.8	99.9	102.0	100.9	98.8	100.6
16	99.8	99.7	100.6	100.0	109.0	98.0	119.2	108.7
LSD	NS	NS	NS	NS	10.8	14.0	11.5	8.2
GM	93.3	93.6	96.3	100%	81.5	87.6	100.9	100%
CV	0.6	0.7	0.7	0.3	9.4	9.8	10.0	4.9

USDA Single-Cross Test - 1974

Hamler, Ohio Variety			PERFORMANCE AS % OF GENERAL MEAN (GM) OF TEST					
			RWS/A	Tons/A	RWS/T	% Sucrose	% CJP	Beets /100'
UI101066ms	x	SP6822-0	92.99	96.26	95.99	96.57	99.75	91.84
UI101066ms	x	EL40	106.33	109.98	96.72	97.28	99.77	99.21
UI12166	x	EL40	100.59	100.34	100.01	99.32	100.39	99.91
SP71614-01	x	SP6922-0	104.43	99.60	104.95	103.47	100.68	106.57
SP70689-01	x	SP6922-0	105.94	104.10	101.97	101.86	100.01	112.53
SP71720-01	x	SP6922-0	100.28	101.77	98.34	98.79	99.79	98.51
SP70620-01	x	SP6922-0	93.33	94.25	99.08	99.88	99.60	102.36
SP70745-02	x	SP6922-0	111.04	106.11	104.75	104.21	100.18	112.88
SP71621-01	x	SP6922-0	107.06	101.66	105.51	104.32	100.52	106.22
SP68522-01	x	SP72288-0	98.86	99.12	99.44	99.95	99.73	106.22
SP71550-01	x	SP72288-0	86.95	86.14	100.97	100.11	100.47	92.90
SP70641-01	x	SP72288-0	94.72	92.45	102.25	101.84	100.18	78.87
SP70682-01	x	SP72288-0	107.04	110.88	96.54	97.64	99.48	104.46
SP70720-01	x	SP72288-0	95.89	95.89	99.37	99.09	100.14	93.60
SP70735-01	x	SP72288-0	90.56	94.72	96.04	97.14	99.49	98.51
USH20			103.99	106.54	98.06	98.46	99.82	95.35
	LSD 5% as % GM		NS	13.15	6.03	4.90	0.70	14.47
	GM		5093.59	18.87	269.43	16.54	92.62	79.23
	CV %		13.52	11.44	5.25	4.26	0.61	12.59

Figure 1. pH of Normal and CMS anthers from pollen mother cells to mature pollen.



AG02-020 AG12 25906 USDA-6
Torrington, Wyoming

Planted 4/18/74
Harvested 10/9/74

HOLLY SUGAR CORPORATION
EXPERIMENTAL PLOT ANALYSIS

VARIETAL DATA

Variety Description	Lbs Ext Sugar /Acre	Lbs Ext Sugar Per Ton	Tons Beets /Acre	Percent Sucrose	Beets Per 100'	Bolting Percent
70689-01xSP6922-0	+ 7647	316.9	+ 24.2	18.52	117	0.0
71614-01xSP6922-0	7379	311.0	+ 23.7	18.30	117	1.1
69514-01x72288-0	7320	316.2	23.1	18.49	121	0.0
70682-01xSP72288-0	7320	308.3	+ 23.7	18.20	119	1.1
70550-01x7042x7288	7116	321.1	22.1	18.67	114	0.6
(67550x67745A)x72288	7034	- 305.5	23.0	- 18.10	116	0.0
70720-01xSP72288-0	6862	- 299.9	22.9	- 17.89	115	0.6
70641-01x72288-0	6828	308.0	22.1	18.19	117	0.0
(67550x67527A)x72288	6817	314.3	21.7	18.42	119	0.0
(69561x7042)x72288	6734	320.2	21.0	18.63	116	0.0
(69561x7042)x6922-0	6725	313.9	21.5	18.41	120	1.1
70745-02xSP6922-0	6663	- 305.1	21.8	- 18.08	117	0.6
68522-01x72288-0	6652	313.0	21.2	18.37	119	0.0
71621-01xSP6922-0	6592	- 297.1	22.2	- 17.78	117	0.6
72730-01xSP6922-0	6506	312.5	20.8	18.36	117	0.0
71720-01xSP6922-0	6440	- 289.2	22.2	- 17.48	120	0.6
70620-01xSP6922-0	6415	- 295.4	21.7	- 17.72	117	0.0
(68533x67550)x72288	6383	314.3	20.3	18.42	116	0.0
70618-01xSP6922-0	6358	- 302.6	21.0	- 17.99	120	0.6
72730-01xSP72288-0	6338	311.6	20.3	18.32	116	0.0
(67550x67557A)x72288	6272	311.7	20.1	18.32	120	0.0
71550-01x72288-0	6108	321.0	19.0	18.67	116	0.0
Grand Mean	6750	309.5	21.8	18.24	118	0.3
Coeff. of Variation	10	3.7	9.3	2.36		
Standard Error, Mean	285	4.7	0.8	0.18		
Least Sig. Diff	799	13.2	2.3	0.49		
Calculated f (Var.)	2.05**	3.25**	2.47**	3.27**		

AG02-020 AG12 21907 USDA-7
Sidney, Montana

Planted 5/01/74
Harvested 9/27/74

HOLLY SUGAR CORPORATION
EXPERIMENTAL PLOT ANALYSIS

VARIETAL DATA

Variety Description	Lbs Ext Sugar /Acre	Lbs Ext Sugar Per Ton	Tons Beets /Acre	Percent Sucrose	Beets Per 100'	Bolting Percent
H65-02-64x93101-0	6454	284.6	22.7	17.31	109	0.4
EL36C2xSP6322	6216	- 261.9	23.7	- 16.42	118	1.9
(SP7042xFC506)x6822	6213	- 268.1	23.1	- 16.67	113	2.7
(EL36C2xEL38)xEL40	6094	- 271.1	22.5	- 16.78	120	1.5
(FC506MSxEL38)x6822	6014	- 269.2	22.3	- 16.71	119	3.0
EL38C2xEL40	5976	- 272.2	22.0	- 16.83	113	0.4
(FC506MSxEL38)xEL40	- 5859	- 277.7	21.1	- 17.04	116	0.8
EL38C2xSP6822	- 5848	- 255.7	22.9	- 16.17	110	3.6
(70550x7042)xEL40	- 5840	289.4	- 20.2	17.49	120	0.7
(SP6923xEL36)xEL40	- 5679	- 273.6	20.8	- 16.88	115	0.0
(SP7042xEL38)xEL40	- 5678	279.4	- 20.3	17.11	114	1.2
(EL36C2xEL38)x6822	- 5675	- 263.6	21.5	- 16.49	112	4.0
SP70641xEL40	- 5660	282.2	- 20.1	17.22	114	0.4
(SP7042xEL38)x6822	- 5617	- 263.3	21.3	- 16.48	115	3.5
(SP71550xEL38)xEL40	- 5613	288.9	- 19.4	17.47	118	0.4
(SP7042xEL36)xSP6322	- 5613	282.3	- 19.9	17.22	116	0.8
(SP7042xFC506)xEL40	- 5603	283.9	- 19.7	17.28	118	0.8
SP72730xEL40	- 5592	284.9	- 19.6	17.32	117	0.4
(FC506xEL36)xSP6322	- 5586	- 264.2	21.1	- 16.51	114	3.9
(SP6923xEL36)x6822	- 5579	- 259.6	21.5	- 16.33	113	0.8
(69561x7042)xEL40	- 5549	288.3	- 19.3	17.45	119	0.7
(SP71550xEL38)x6822	- 5511	- 271.1	- 20.3	- 16.78	114	2.7
(69561x7042)x6822	- 5473	279.6	- 19.6	17.12	112	2.8
SP70641-01xSP6822-0	- 5466	- 269.8	- 20.3	- 16.73	107	0.4
SP72730-01xSP6822-0	- 5462	- 271.3	- 20.1	- 16.79	118	0.4
(70550x7042)x6822	- 5248	282.2	- 18.6	17.22	113	3.5
SP69514-01xSP6822-0	- 5087	- 270.8	- 18.8	- 16.77	108	6.6
SP69514xEL40	- 4914	282.3	- 17.4	17.22	116	3.1
Grand Mean	5683	274.7	20.7	16.92	115	1.8
Coeff. of Variation	11	2.6	10.6	1.65		
Standard Error, Mean	200	2.4	0.7	0.09		
Least Sig. Diff	559	6.6	2.0	0.26		
Calculated f (Var.)	2.75**	16.20**	4.24**	16.17**		

Annual Report of Research on Sugarbeet Diseases in 1974

C. L. Schneider

1. Aphanomyces cochlioides oospore inoculum.

a. Longevity - Dried oospore inoculum lots initiated blackroot infection of sugarbeet seedlings in greenhouse inoculation tests after storage periods of up to 52 months at -9 and +5 C°.

b. Effect of inoculum placement - In greenhouse tests, inoculum applied on the soil surface at planting, resulted in significantly lower disease severity level in seedlings than inoculum applied 2.5 cm below seed level, at seed level and 0.6 cm above seed. Inoculum applied on the surface 6 days after planting resulted in significantly lower disease severity than inoculum applied at planting. Disease incidence (no. plants with symptoms/no. plants inoculated) was 100% in each case.

2. Aphanomyces screening test (with G. J. Hogaboam).

In greenhouse tests, 130 monogerm and multigerm breeding lines were screened for resistance to A. cochlioides. Oospore density ranged from $1\text{-}5x10^4$/4-in. pot, according to replication. Variety US H20 was included as a check variety. Approximately 30 days after emergence, which averaged ca. 15 plants/pot for most entries, mean disease severity ratings were determined according to a numerical index which ranged from 0(healthy) to 5(dead). The distribution of entries, according to disease reaction in relation to that of US H20, which = 2.8, was as follows:

Disease reaction class	Pct. entries in each class
More susceptible than ck.	8.5%
No sig. difference	76.1%
More resistant than ck.	15.4%

3. Field test of blackroot resistance.

In a field naturally infested with blackroot pathogens, including A. cochlioides, 9 entries in the F & M regional evaluation tests plus a local check variety, were tested for productivity. Among the entries there were significant differences in emergence stand, pre-harvest stand, foliage quantity estimate and infrared photo-ratings. Differences in root yield/plot were not significant.

4. Remote sensing studies (with G. R. Safir).

a. Infrared photography - The use of infrared (IR) color aerial photography for pre-harvest evaluation of sugarbeet plots exposed to blackroot disease was investigated. On 21 Aug. 35 mm aerial photographs at 457 m altitude were obtained of two adjacent field experiments that included

11 different sugarbeet varieties in a total of 140 single-row plots, each 5.2 m long. On an enlarged print (1:345), each plot was rated according to an index that ranged in color from cyan blue to magenta, and numerically, from 1-10. The ratings, based on color, indicated foliage quantity (stand x foliage vigor).

IR photo ratings correlated highly with stands (r + .66**), foliage vigor ratings (.73**), foliage quantity estimates (.83**) and root wt./plot (.78**). There were significant differences among varieties in IR photo ratings, which were indicative of their differences in blackroot disease susceptibility. Differences in productivity, attributable to local differences in degree of blackroot exposure in the field, were readily indicated by the IR photo technique.

b. Leaf diffusive resistance as an indicator of root rot severity - Sugarbeet seedlings at 4 weeks of age were inoculated with A. cochlioides zoospores (10^6/4-in. pot) and diffusive resistances of leaves to vapor flow were determined with a diffusion porometer. Two varieties, highly susceptible SP63269-2 and less susceptible SP6822-0, were tested. By 5 days after inoculation, diffusive resistances of SP63269-2 averaged 4.5 sec cm^{-1}, whereas resistances of SP6822-0 averaged 2.6 sec cm^{-1}, although differences in severity of root rot symptoms were not yet apparent. Differences were significant at the 1% level. Noninoculated control plants of both varieties averaged 1.6 sec cm^{-1}.

5. Crown rot studies.

a. Virulence of Rhizoctonia isolates - Plants of relatively resistant line FC701/5 were exposed to portions of Rhizoctonia infected sugarbeet roots from field collections throughout Michigan and Ohio. Among 68 plants tested, 44 became infected. Virulence of cultures isolated from test plants was tested on subsequent plantings of FC701/5. Among 18 isolates tested in 1974, none was as virulent as RS-12, the most virulent culture in our collection, which has been used since 1970 for experimental inoculations in screening breeding lines for Rhizoctonia resistance.

b. Greenhouse inoculation techniques - Studies were continued toward development of greenhouse and growth chamber inoculation techniques for evaluation of seedling resistance to Rhizoctonia. Inoculation methods studied included: 1) growing seedlings in 4-in. pots of sterile soil inoculated with dilute lima bean agar cultures of R. solani in a growth chamber at 17-18.5° C; 2) application of mycelial suspensions of blenderized mycelial mats of R. solani (diluted with volume of water equal to 18-32-fold x vol. of liquid nutrient in which inoculated) at base of 4-week old seedlings in 6-in. pots. With both methods, disease severity was consistently greater in the susceptible commercial variety than in moderately resistant, FC701/5, but variability within treatments was relatively high, and varietal differences were not statistically significant.

6. Rhizoctonia nursery (with G. J. Hogaboam).

In field plots at East Lansing, 231 breeding lines were screened for Rhizoctonia resistance. There were 7 experiments, each comprising 33 entries in single-row plots, 5.2 m long, replicated three times. Each experiment also included three check varieties: US H20, US H21, and (71550-01xEL38), representative of commercial types presently grown in the Great Lakes area. Dry barley inoculum was applied in the center of the plant row with a tractor-mounted granule applicator, modified for dry inoculum use. Dates and dosages of inoculum application were: 10 July (20 ml/m), 7 Aug. (9 ml/m) and 9 Aug. (30 ml/m).

In late September, each plant was rated according to severity of above-ground symptoms of crown rot according to an index: 0(healthy); .25 (light infection); .5 (severe infection); 1.0 (dead). A percentage rating, expressing incidence and severity of disease, was then obtained for each plot by summating the individual plant ratings and dividing by the post-thinning stand and multiplied by 100.

The mean disease rating of the three check varieties in all experiments = 60.7, whereas that of resistant variety FC701/5 = 30.7, indicating that the disease intensity level was sufficient for distinguishing between resistant and susceptible types. The distribution of the 231 test entries, according to disease severity rating compared with that of the 3-check average (significance at 5% level) was as follows:

Reaction class	No. entries in each class
More susceptible	1
No difference	153
More resistant	77

Plots of entries rated as more resistant than the checks were harvested, and the most resistant-appearing plants were selected as mother beets for subsequent use in the breeding program.

7. Tests of fungicides to control crown rot (with H. S. Potter and D. L. Reichard).

Field plots of variety US H20 were mechanically side-dressed with dried sorghum grain inoculum of R. solani at the rate of 11.5 ml/m on 3 July. In one experiment the following treatments, applied as aqueous sprays at 60 gal/A along the plant row with a tractor-mounted sprayer on 9 and 17 July resulted in crown-rot incidence significantly lower than non-treated control: chlorothalonil (1.5 lb a.i./A), and carboxin (2.0 lb). Treatments less effective included fentin hydroxide (4.8 oz) and benomyl (4 oz). The addition of a foaming agent to aid in placement of the chemicals did not significantly affect the efficacy of the fungicides.

In another experiment with 11 fungicidal sprays, one granular treatment and one antibiotic treatment, applied 3 times at two-week intervals, the following resulted in crown rot incidence below that of the general mean: benomyl (6 oz a.i./A), carboxin (2.0 lb), and fentin hydroxide (4.8 oz).

8. The effect of cropping systems and rotation on crown rot incidence.

Disease surveys were conducted for the second consecutive year on sugarbeet plots in the cropping system and sequence study established by the Michigan State University Crop and Soil Sciences Department, at the Saginaw Valley Bean and Beet Research Farm. In this study are compared the effects of four cropping systems, each with 2, 3, and 4-year rotation periods, on productivity of various crops, including sugarbeet. In 1974, the third year of the experiment, incidence of savoy, Cercospora leaf spot, blackroot, and crown rot diseases were extremely low. Crown rot incidence, however, tended to be significantly lower in the corn-beet sequence (0.6 infected plants/30.5 m of row) than in corn-bean-beet (4.1 plants), bean-beet (8.9 plants) or alfalfa-oats-bean-beet (2.8 plants) sequences. A similar trend was noted in 1973.

PHYSIOLOGICAL INVESTIGATIONS - 1974

F. W. Snyder

Germination and Emergence Studies

In 1973, Garth Larsen at Salem, Oregon harvested seed by individual plant. A western and an eastern cultivar were used. Time of first bloom was taken when about half of the plants had open flowers. Using weather data from the Salem weather station, Heat Units (HU) per day were accumulated by the formula, HU = Mean temperature - 45° F. When 800 HU accumulated one half of the branches on each plant were harvested bilaterally and vertically. The remaining branches were harvested when 1,100 HU had accumulated. Seeds from 27 plants of each cultivar were hand processed to remove the corky material. Seventy-two seeds from each plant for each harvest were used in the blotter-germination test and 72 in the sand-emergence test (see 1973 report for details of test).

1. The eastern cultivar appears to require less HU for seed development and ripening than the western cultivar. When harvested at 800 HU, the western cultivar germinated 84±13% and emerged 50±17%, whereas the eastern cultivar germinated 95±6% and emerged 81±11%. When they were harvested at 1,100 HU each germinated 98%. The western cultivar emerged 88% and the eastern 90%.

2. Although more precise data are needed, tentatively, about 1,100 HU are required for development and ripening of seeds of these two sugarbeet cultivars.

3. This study further confirms that the sand-emergence test determines more precisely when sugarbeet seeds are physiologically mature than the blotter-germination test.

Growth Analysis of Sugarbeet Seedlings

In order to carry out studies on the effect of selection pressure on the Growth-Partitioning Ratio (GPR) for taproot growth, the data must be gotten without sacrificing the seedling. With the present technique, a high percentage of selected seedlings grown for 22 days after emergence in the growth chamber survive and produce seed. After the data are recorded, the remaining portion of the seedling (growing point, hypocotyl, and taproot freed of fibrous roots) is re-planted in the pot in which it had grown. Actually, the GPR

$$= \frac{\text{Taproot-hypocotyl fresh weight.}}{\text{Leaf blade fresh weight}}$$

Summary of findings:

1. When taproot-hypocotyl fresh weights are plotted against leaf blade fresh weights for the original population and progenies of parents selected for the highest and lowest GPR, the slopes of the regression lines

for each of the three groups are statistically significant at the 1% level. Thus, the CPR is a heritable trait.

2. The mean CPR values for different breeding lines differ.

3. Limited data on progenies grown for 70 days after planting in the field indicate that the percentage differential in CPR at 22 days in the growth chamber is maintained when grown for the longer time in the field.

A second selection of plants within the first progeny groups has been made.

Tissue and Anther Culture

Relatively little time has been available for this project. We have gotten better growth by using different media, but we have not had generation of complete plantlets.

BREEDING SUGARBEETS FOR RESISTANCE TO BLACK ROOT AND LEAF SPOT

G. E. Coe

Research work on sugarbeets at the Agriculture Research Center-West, Beltsville, Md., is directed mainly toward varietal improvement in resistance to Aphanomyces black root and Cercospora leaf spot, important diseases in eastern United States.

Some results of this work are set forth in this report.

Breeding for Black Root Resistance

Small increases in resistance to black root resistance are apparent, although direct comparisons with tests previous to 1972 are not possible because a more resistant check variety has been used since 1971. In 1971, there were almost no lines equal or superior to 7134-0 in black root resistance. Almost all were slightly less resistant. In 1973, many lines were equal or superior to SP7134-0 as shown in Table 1.

Table 1. Results of greenhouse black root testing in 1973-74.

	Number progenies tested	As good or better than SP7134-0		Worse than SP7134-0	
		No.	%	No.	%
MM selections from leaf spot nursery	201	41	20.4	160	79.6
MM selections from G.H. black root tests	142	53	37.3	89	62.7
MM selections from MM progeny 70323-38	23	16	69.5	7	30.5
mm selections from leaf spot nursery	69	30	43.5	39	56.5

Only enough selection pressure is now being applied to maintain present levels of black root resistance. We are applying increased selection pressure for higher root yields, emergence vigor, and soil-free roots. Present levels of resistance in our breeding material far exceed the black root resistance of USH20.

Breeding for Leaf Spot Resistance

The level of leaf spot resistance in our breeding material also far exceeds that of USH20 as shown in Table 2.

Table 2. Average leaf spot resistance of sugarbeet breeding lines in the 1974 Beltsville nursery.

	Average leaf spot resistance*
66 multigerm progenies	2.42
52 monogerm progenies	2.15
USH20	4.58
SP6922-0 (resistant check)	3.25

*Scale of leaf spot readings=0 to 10; 0=no leaf spot, 10= all leaves dead from leaf spot.

Here, also, only enough selection pressure is being applied to maintain present levels of resistance, and greater selection pressure is now being applied for higher yield and improved purity.

The level of leaf spot resistance of new monogerm 0-types and their male-sterile companion lines is also good as indicated by the data in Table 3.

Table 3. Leaf spot ratings of new 0-types and their MS companion lines in 1974 Beltsville nursery.

Variety designation	Leaf spot rating*	Variety designation	Leaf spot rating
75576-0 mm 0-type	3.00	75581-0 mm 0-type	2.75
" -01 mm MS	2.50	" -01 mm MS	4.00
75577-0 mm 0-type	2.50	75582-0 mm 0-type	2.00
" -01 mm MS	2.50	" -01 mm MS	2.00
75578-0 mm 0-type	3.50	75583-0 mm 0-type	2.75
" -01 mm MS	2.50	" -01 mm MS	2.50
75579-0 mm 0-type	2.00	75584-0 mm 0-type	3.75
" -01 mm MS	2.25	" -01 mm MS	2.25
75580-0 mm 0-type	3.25	75585-0 mm 0-type	3.00
" -01 mm MS	2.00	" -01 mm MS	1.50
		SP6922-0 MM resistant check	3.50

*Scale 0 to 10. 0=no spots on leaves, 10=all leaves dead with leaf spot.

All of these 0-types except one are as good or better than SP6922-0 in leaf spot resistance, and will be useable if they prove to have good combining ability and good quality characteristics.

Leaf spot tests were also conducted on 19 F_1 progenies of crosses between sugarbeets and Beta maritima from Italy and King's Lynn, England. Only one of these F_1 progenies appeared to have leaf spot resistance equal to the ♀ sugarbeet parent SP6922-0. Table 4 shows the leaf spot rating frequency distribution of these progenies.

Table 4. Leaf spot rating frequency distribution of F_1 sugarbeet X B. maritima progenies.

Average leaf spot rating	No. of progeny
3.00	1
3.25	0
3.75	1
4.00	7
4.25	3
4.50	2
4.75	3
5.00	2
Leaf spot rating of SP6922-0 = 3.25	

The prospects of obtaining highly leaf spot resistant breeding lines from these B. maritima sources does not appear to be good.

In 1972, seed for B_3 progenies of crosses between sugarbeets and Beta corolliflora were obtained from Dr. Helen Savitsky. Seed increases were made from selected roots from this B_3 line, and these B_3-F_1 lines were tested for leaf spot resistance in 1974. Table 5 shows the leaf spot rating frequency distribution of these progenies.

Table 5. Leaf spot rating frequency distribution of B_3-F_1 progenies of sugarbeet X B. corolliflora.

Average leaf spot rating*	No. of progeny
4.00	1
4.25	4
4.50	12
4.75	4
5.00	8
5.25	8
5.50	1
5.75	1
Leaf spot rating of SP6922-0 = 3.25	
" " " " USH9B = 5.00	

*Scale 0 to 10. 0=no leaf spot; 10=all leaves dead.

The sugarbeet lines used in this crossing work were not leaf spot resistant, and it is a bit surprising that about half of these progenies had leaf spot ratings better than the susceptible check variety. It is possible that B. corolliflora contains new genes for leaf spot resistance.

In cooperation with Dewey Stewart, retired, selfed progenies from two sources of B. maritima were tested for leaf spot resistance. The first eight B. maritima selfed lines in Table 6 came from plants selected from a seed collection from Denmark. The last 10 lines came from a seed collection made in Kilmore, England.

Table 6. Leaf spot ratings of selfed Beta maritima progenies at Beltsville, Md., 1974.

Variety	Leaf spot rating*	Variety	Leaf spot rating
SP733021.	3.50	SP733030.	5.00
SP733022.	6.00	SP733031.	4.00
SP733023.	3.00	SP733032.	5.00
SP733024.	4.00	SP733033.	4.50
SP733025.	2.50	SP733034.	4.50
SP733026.	5.00	SP733035.	7.00
SP733027.	3.00	SP733036.	4.00
SP733028.	4.50	SP733037.	3.50
Av.	3.94	SP733038.	3.50
		SP733039.	4.00
		Av.	4.50

*Scale 0 to 10. 0=no leaf spot; 10=all leaves dead.

The two collections from which these selfed progenies were produced were found to be among the most resistant Beta maritima collections ever introduced to the U.S. Some variation in leaf spot resistance among plants within individual seed collections had been noticed previously, but the amount of this variation was not recognized until the present tests were conducted. In the future crosses will be made to sugarbeets using only the most resistant B. maritima plants as indicated by progeny tests (preferably selfed progeny).

Promising Male-Sterile Lines

In 1974 nursery tests, three male-sterile lines performed well in hybrid combinations. These lines should be tested again in field trials, and they should be used in producing F_1 male-sterile lines for further crossing and testing work. These include SP71614-01, SP71621-01, and SP70682-01. Hybrids of SP70682-01 produced good yields at two locations but were slightly low in sugar content in the Ohio nursery. One F_1 male-sterile line (69550-01 X 70745-0), crossed with SP6922-0 did very well in yield, sugar, and purity in two locations and should be tested further.

Breeding for Smooth Soil-Free Roots

Nursery tests in 1974 were run on 199 progenies supposedly segregating for the globe-shaped characteristic. Globe-shaped roots, comparatively free of root hairs, were recovered from relatively few of these progenies. However, it was noted that many of the spindle-shaped roots were extremely smooth and almost devoid of root hairs. These came out of the ground with almost no soil adhering to the roots, and they have been selected for further breeding work. It is possible that "soil-free" spindle-shaped roots can be produced.

At the 1974 ASSBT meetings, Dr. Peter Bergen reported successful selection for the smooth root characteristic in his sugarbeet breeding stocks. Selections for smooth roots were made at Beltsville from about 1/4 acre of SP6922-0 PF. About 100 relatively smooth roots were obtained and have been planted in our greenhouse ground bed for seed increase and hybridization with SP73550-01 mm MS. Seed from these should be available in time for testing in 1975.

ABSTRACTS OF PAPERS PUBLISHED IN 1974, EAST LANSING AND BELTSVILLE

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Growth of noncompetitive plants of locally adapted hybrid cultivars was compared for 113 days. At 50 days maize had produced no more dry matter (includes fibrous roots) per unit leaf area than sugarbeet. At 113 days (maize essentially mature), maize averaged 66.8 mg dry matter per cm^2 of leaf area and sugarbeet only 46.4; the ratio for maize:sugarbeet was 1.44:1.00. Individual plants of both species differed markedly in producing dry matter per unit leaf area. The values for sugarbeet ranged from 31.4 to 55.1 mg per cm^2.